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Attorney Docket No. 2950.25US01

APPEAL BRIEF TRANSMITTAL

In re the application of:

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|---|---|---|
| | Kumar et al. | Confirmation No.: 1810 |
| Application No.: | 09/136,483 | Examiner: Marcheschi, M. |
| Filed: | August 19, 1998 | Group Art Unit: 1793 |
| For: | ALUMINUM OXIDE PARTICLES | |

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Transmitted herewith, in triplicate, is the Appeal Brief in the above-identified application, with respect to the Notice of Appeal filed on January 16, 2008.

[ X ] Applicant(s) is/are entitled to small entity status in accordance with 37 CFR 1.27.

[ X ] A check in the amount of [ ] $500.00 (large entity) [ X ] $250.00 (small entity) to cover the filing fee.

Respectfully submitted,

Peter S. Dardi

Peter S. Dardi, Ph.D.
Registration No. 39,650

*Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 50-3863.*

CERTIFICATE OF MAILING

I hereby certify that this document is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on

March 17, 2008
Date of Deposit

Peter S. Dardi
Peter S. Dardi, Ph.D.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| In re the application of: | Attorney Docket No.: 2950.25US01 |
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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

# BRIEF FOR APPELLANT

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| In re the application of: | Attorney Docket No.: 2950.25US01 |
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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES
APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

## INTRODUCTORY COMMENTS

This is an appeal of the final rejection of claims 1-3, 5-8, 11-16, and 19-22. A Final Rejection was mailed on October 17, 2008. A Notice of Appeal was filed January 16, 2008. This Appeal Brief is thus timely filed.

*Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 50-3863.*

CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that this paper is being transmitted by facsimile to the U.S. Patent and Trademark Office, Fax No. 571-273-8300 on the date shown below.

March 17, 2008
Date

Peter S. Dardi
Peter S. Dardi, Ph.D.

## REAL PARTY IN INTEREST

NanoGram Corporation, a corporation organized under the laws of the state of Delaware, and having offices at 165 Topaz St., Milpitas, California, has acquired the entire right, title and interest in and to the invention, the application, and any and all patents to be obtained therefore, as per the Assignment, recorded at Reel 9402, Frame 0196 from the inventors to NeoPhotonics Corporation (then named NanoGram Corporation) and an assignment from NeoPhotonics Corporation to NanoGram Corporation, recorded at Reel 013957, Frame 0076. Note that NeoPhotonics Corporation was formerly called NanoGram Corporation, and the present NanoGram Corporation was previously a wholly owned subsidiary of NeoPhotonics Corporation following the formal name change. The present NanoGram Corporation is now an independent corporation.

## RELATED APPEALS AND INTERFERENCES

This application was subject to earlier appeals before the Board of Patent Appeals and Interferences (BPAI) and U.S. Court of Appeals for the Federal Circuit (CAFC). A copy of the decisions from the BPAI (Appeal 2001-1031) and CAFC (Appeal 04-1074) are attached in the Appeals Appendix. The CAFC vacated the BPAI's decision and remanded the case for further consideration.

In the earlier appeals, claims 1-3 and 5-22 were subject to appeal. In the instant appeal, claims 1-3, 5-8, 11-16, and 19-22 are subject to appeal with claims 9 and 10 previously cancelled and claims 17 and 18 allowed based on the Board decision (Appeal 2001-1031). Additionally, claim 11 depends from claim 1 instead of claim 9 and claims 12-16 depend from claim 11 instead of claim 9.

Furthermore, the present assignee has several unrelated appeals pending. In particular, U.S. patent application serial number 09/969,025, referenced below in the context of an obviousness-type

double patenting rejection, is currently on appeal. However, the issues in that appeal are unrelated to the present appeal.

## STATUS OF CLAIMS

Claims 1-3, 5-8, and 11-22 are pending. Claims 4, 9 and 10 are canceled. Claims 1-3, 5-8, 11-16, and 19-22 stand rejected, and claims 17 and 18 are allowed. The pending claims are listed in the Claims Appendix.

## STATUS OF AMENDMENTS

No claims have been amended after final rejection. A Notice of Appeal was filed on January 16, 2008 in response to the Final Office Action dated October 17, 2007.

## SUMMARY OF CLAIMED SUBJECT MATTER

The present invention is directed to highly uniform submicron aluminum oxide particles (claims 1 and 19), polishing compositions using the aluminum oxide particles (claim 11), and methods for producing the aluminum oxide particles (claim 17). The small diameter and high degree of uniformity of the aluminum oxide particles is desirable for forming abrasive or polishing compositions for planarization, such as chemical-mechanical polishing. See the specification, for example, at page 4, lines 13-18.

The average diameter of aluminum oxide particles can be from about 5 nm to about 500 nm (claims 1, 17, and 19), from about 5 nm to about 100 nm (claim 18), and from about 5 nm to about 25 nm (claim 2). The aluminum oxide particles can have a cubic crystal structure $\gamma$-$Al_2O_3$ (claims 3 and 20).

The size uniformity of the particles can be expressed in terms of a narrow peak in the particle size distribution (i.e. particle sizes around the average drops off very quickly). The particle size distribution can be such that at least about 95 percent (claims 6 and 19) or at least about 99 percent (claims 8 and 21) of the particles have a diameter greater than about 40 percent of the average diameter and less than about 160 percent of the average diameter or at least about 95 percent of the particles have a diameter greater than about 60 percent of the average diameter and less than about 140 percent of the average diameter (claims 7 and 22). The particle size distribution is independent of the average particle size. Thus, a ping pong ball and a basket ball can have roughly the same average particle sizes as two softballs, but that does not mean that the particles collections have the same properties.

The uniformity of the particles can also be expressed in terms of a tail-less particle size distribution in which a plot of particle diameters does not have a tail at large diameters (i.e. no primary particles have diameters significantly larger than the average or above a certain cut off value). See the specification, for example, at page 3, line 29-page 4, line 1 and page 20, lines 16-21. The particle collection can have a particle size distribution with less than about one in $10^6$ particles having a diameter greater than about two times (claim 5) or three times (claim 1) the average diameter of the particles.

Although both concepts of particle size distribution relate to overall particle size distribution, the narrow distribution about the average is independent from the lack of a tail in the distribution. For example, a distribution could be narrow near its peak but have a tail at larger diameters. Applicants have produced powders with a distribution of particle sizes that is both narrow near its peak and without a tail at larger distributions. See, for example, Fig. 11. The uniformity of a particle collection can lead to improved properties for selected applications, such as surface polishing, where the uniformity can lead to reduced surface scratching.

The production of highly uniform particles is enabled by the use of laser pyrolysis (claims 17 and 18). Unlike standard chemical reactions under equilibrium conditions, the light beam defines a reaction zone in which the reaction is driven to completion. See the specification, for example, at page 4, line 34 to page 5, line 2, page 6, lines 16-27 and page 12, lines 12-23. See the drawings, for example, Figs. 2 and 3. The extreme amounts of heat in the reaction zone tends to dissociate reactants within the reaction zone. The species then recombine to form the product compositions. The reaction is rapidly quenched as the particles leave the reaction zone. See the specification, for example, at page 12, lines 12-23. This quenching terminates further reaction and corresponding particle growth. The reaction conditions can be adjusted to form a certain crystalline aluminum oxide structure, such as cubic crystal structure $\gamma$-$Al_2O_3$ (claims 3 and 19).

The highly uniform submicron aluminum oxide particles can be used in a polishing composition (claims 11-16). The polishing composition can have from about 0.05 to about 15 weight percent or 1.0 (claim 11) to about 10 (claim 12) weight percent of aluminum oxide particles and comprise of colloidal silica (claim 16) or other abrasive particles such as silicon carbide, metal oxides other than aluminum oxide, metal sulfides, or metal carbides (claim 15). The polishing composition can also be in the form of an aqueous (claim 13) or nonaqueous (claim 14) dispersion.

## GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. The rejection of claims 1-3, 5-8, and 19-22 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Rostoker et al. (US Patent 5,389,194).

2. The rejection of claims 11-16 under 35 U.S.C. § 103(a) as obvious over Rostoker et al. (US Patent 5,389,194) in view of Farkas et al. (US Patent 6,001,730).

3. The provisional rejection of claims 1-3, 5-8, and 19-22 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over all the claims of copending Application No. 09/969,025.

## ARGUMENT

### GROUPING OF CLAIMS

Appellant argues the claims as a single group and acknowledge that the claims stand or fall together.

### LEGAL AUTHORITY

The Court of Appeals for the Federal Circuit has exclusive appellate jurisdiction for cases arising under the patent law under 28 U.S.C. § 1295 (a)(1). Federal Circuit patent law is subject to review by the U.S. Supreme Court, and the Supreme Court occasionally rules on patent cases that provide ultimate authority for interpreting the patent statutes. The Federal Circuit has adopted as binding precedent all holding of its predecessor courts, the U.S. Court of Claims and the U.S. Court of Customs and Patent Appeals. South Corp. v. U.S., 215 USPQ 657 (Fed. Cir. 1982). Therefore, unless they have been overruled *en banc* or by the Supreme Court, CCPA cases are binding precedent for the present appeal.

A. LEGAL BACKGROUND - ANTICIPATION

1. Burden of Persuasion

The Examiner has the burden of establishing a prima facie case of anticipation. As such, the Examiner must provide a reference that discloses every element as set forth in the claim. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." Verdegaal Bros. v. Union Oil Co. of California, 814 F2d. 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987) (MPEP §2131).

2. A Single Reference Must Identically Disclose Every Element Set Forth In a Claim To Anticipate The Claim

"In order to constitute anticipatory prior art, a reference must identically disclose the claimed compound..." MPEP 2122 citing In re Schoenwald, 22 USPQ2d 1671, (Fed. Cir. 1992). "For a prior art reference to anticipate in terms of 35 U.S.C. § 102, **every element of the claimed invention must be identically shown in a single reference**. These elements must be arranged as in the claim under review, but this is not an 'ipsissimis verbis' test." In re Bond, 15 USPQ2d 1566, 1567 (Fed. Cir, 1990)(Internal citations omitted and emphasis added.).

"If the prior art reference does not expressly set forth a particular element of the claim, that reference still may anticipate if that element is 'inherent' in its disclosure. To establish inherency, the intrinsic evidence 'must make it clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" In re Robertson, 49 USPQ2d 1949, 1950, 1951 (Fed. Cir. 1999), citing Continental Can Co. v. Monsanto Co., 20 USPQ2d 1746, 1749 (Fed. Cir. 1991).

"Every element of the claimed invention must be literally present, arranged as in the claim. **The identical invention must be shown in as complete detail as is contained in the patent claim**." Richardson v. U.S. Suzuki Motor Corp., 9 USPQ2d 1913, 1920 (Fed. Cir. 1989)(Internal citations omitted, and emphasis added.); see also MPEP 2131. "Here, as well, anticipation is **not** shown by a prior art disclosure which is only 'substantially the same' as the claimed invention." Jamesbury Corp. v. Litton Industrial Products, Inc., 225 USPQ 253, 256 (Fed. Cir. 1985)(emphasis added).

B. LEGAL BACKGROUND - OBVIOUSNESS

1. The Examiner Bears The Burden Of Demonstrating Obviousness.

The Examiner has the burden of persuasion in showing that the Appellant is not entitled to a patent. "[T]he conclusion of obviousness vel non is based on the preponderance of evidence and argument in the record." In re Oetiker, 24 USPQ2d 1443, 1445 (Fed. Cir. 1992). The patent office has the ultimate burden of persuasion in establishing that an applicant is not entitled to a patent. Id. at 1447, concurring opinion of Judge Plager. **"The only determinative issue is whether the record as a whole supports the legal conclusion that the invention would have been obvious."** Id.

"In rejecting claims under 35 U.S.C. §103, the examiner bears the initial burden of presenting a prima facie case of obviousness." In re Rijckaert, 28 USPQ2d 1955, 1956 (Fed. Cir. 1993). Prima facie obviousness is not established if all the elements of the rejected claim are not disclosed or suggested in the cited art. In re Ochiai, 37 USPQ 1127, 1131 (Fed. Cir. 1995). "The test for obviousness *vel non* is statutory. It requires that one compare the claim's 'subject matter as a whole' with the prior art 'to which said subject matter pertains.'"). "**It is impermissible, however, to simply engage in a hindsight reconstruction of the claimed invention, using applicant's structure as a template and selecting elements from references to fill the gaps.**" In re Gorman, 18 USPQ2d 1885, 1888 (Fed. Cir. 1991)(emphasis added).

If the Examiner fails to establish a prima facie case of obviousness, the obviousness rejection must be withdrawn as a matter of law. In re Ochiai, 37 USPQ at 1131 (**"When the references cited by the examiner fail to establish a prima facie case of obviousness, the rejection is improper and will be overturned."** Emphasis added.).

"To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine

reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations, although a clarification of this issue has been recently provided by the Supreme Court in their *KSR* opinion, as described below. The teaching or suggestion to make the claimed combination and reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)." MPEP 2142.

2. <u>Differences Between The Scope Of The Prior Art And The Claimed Invention Must Be Evaluated</u>

The two initial factual determinations under a Graham analysis of obviousness mandated by the Supreme Court are (A) Determining the scope and content of the prior art and (B) Ascertaining the differences between the prior art and the claims at issue. <u>Graham v. John Deere</u>, 383 U.S. 1, 148 USPQ 459 (1966), see also MPEP 2141. The "factors [recited in Graham] continue to define the inquiry that controls." <u>KSR Int'l Co. v. Teleflex Inc.</u>, 550 U.S. ___(2007), 127 S.Ct. 1727, 1734. In evaluating the differences between the prior art and the claimed invention, the invention as a whole must be considered. See MPEP 2141.02 citing <u>Stratoflex, Inc. v. Aeroquip Corp.</u> 218 USPQ 871 (Fed. Cir. 1983). Similarly, a prior art reference must be considered "as a <u>whole</u>, including portions that would lead away from the claimed invention." See MPEP 2141.02 (emphasis in original) citing <u>W. L. Gore & Associates, Inc. v. Garlock, Inc.</u>, 220 USPQ 303 (Fed. Cir. 1983), <u>cert. denied</u>, 469 U.S. 851 (1984). Under Graham, the evaluation of the teachings is performed from the perspective of a person of ordinary skill in the art. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." <u>KRS Int'l Co.</u>, 550 U.S. at ___, 127 S.Ct. at 1742.

3. <u>There Must Be Teaching or Suggestion In The Art To Modify The Teachings Of the Cited References</u>

The Supreme Court has recently clarified that the examination of the teachings of the prior art should not be performed rigidly. Specifically, "a court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions." KSR Int'l Co., 550 U.S. at ___, 127 S.Ct. at 1731. "Often, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person of ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." Id. at ___, 127 S.Ct. at 1731. The Court noted that "it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." Id. at ___, 127 S. Ct. at 1731. "Under the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed." Id. at ___, 127 S. Ct. at 1731.

4. The References Must Teach Or Suggest All Of The Claim Elements

Prima facie obviousness is not established if all the elements of the rejected claim are not disclosed or suggested in the cited art. In re Ochiai, 37 USPQ 1127, 1131 (Fed. Cir. 1995). ("The test for obviousness *vel non* is statutory. It requires that one compare the claim's 'subject matter as a whole' with the prior art 'to which said subject matter pertains.'"). See also, MPEP 2143.03 "All Claim Limitations Must Be Taught or Suggested," citing In re Royka, 180 USPQ 580 (CCPA 1974). **"To establish prima facie obviousness of a claimed invention, all of the claim limitations must be taught or suggested by the prior art."** MPEP 2143.03.

5. The References Must Provide A Reasonable Expectation Of Success

While a reference is prior art for all that it teaches, references along with the knowledge of a person of ordinary skill in the art must be enabling to place the invention in the hands of the public. In re Paulsen, 31 USPQ2d 1671, 1675 (Fed. Cir. 1994). See also In re Donohue, 226 USPQ 619, 621 (Fed. Cir. 1985). "The consistent criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that this process should be carried out and would have a reasonable likelihood success, viewed in light of the prior art." Micro Chemical Inc. v. Great Plains Chemical Co., 41 USPQ2d 1238, 1245 (Fed. Cir. 1997)(quoting In Re Dow Chemical Co., 5 USPQ2d 1529, 1531 (Fed. Cir. 1988)).

C. LEGAL BACKGROUND – PRIOR ART MUST ENABLE CLAIMED INVENTION

The proposition is well established that the cited art only renders a composition of matter or apparatus unpatentable to the extent that the cited art enables the disputed claims, in other words, if the cited art provides a means of obtaining the claimed composition or apparatus.

> To the extent that anyone may draw an inference from the Von Bramer case that the mere printed conception or the mere printed contemplation which constitutes the designation of a 'compound' is sufficient to show that such a compound is old, regardless of whether the compound is involved in a 35 U.S.C. 102 or 35 U.S.C. 103 rejection, we totally disagree. ... We think, rather, that the true test of any prior art relied upon to show or suggest that a chemical compound is old, is whether the prior art is such as to place the disclosed 'compound' in the possession of the public. In re Brown, 141 USPQ 245, 248-49 (CCPA 1964) (emphasis in original) (citations omitted).

Similarly, see In re Hoeksema, 158 USPQ 596, 600 (CCPA 1968) (emphasis in original):

> We are certain, however, that the invention as a whole is the claimed compound and a way to produce it, wherefore appellant's argument has substance. There has been no showing by the Patent Office in this record that the claimed compound can exist because there is no

> showing of a known or obvious way to manufacture it; hence, it seems to us that the 'invention as a whole,' which section 103 demands that we consider, is not obvious from the prior art of record.
>
> While there are valid reasons based on public policy as to why this defect in the prior art precludes a finding of obviousness under section 103, In re Brown, supra, its immediate significance in the present inquiry is that it poses yet another difference between the claimed invention and the prior art which must be considered in the context of section 103. So considered, we think the differences between appellant's invention as a whole and the prior art are such that the claimed invention would not be obvious within the contemplation of 35 U.S.C. 103.

The Federal Circuit has further emphasized these issues. Assertions in a prior art reference do not support an anticipation or obviousness rejection unless the references place the claimed invention in the hands of the public. Beckman Instruments Inc. v. LKB Produkter AB, 13 USPQ2d 1301, 1304 (Fed. Cir. 1989). "In order to render a claimed apparatus or method obvious, the prior art must enable one skilled in the art to make and use the apparatus or method." Id. While a properly citable reference is prior art for all that it teaches, references along with the knowledge of a person of ordinary skill in the art must be enabling to place the invention in the hands of the public. In re Paulsen, 31 USPQ2d 1671, 1675 (Fed. Cir. 1994). See also In re Donohue, 226 USPQ 619, 621 (Fed. Cir. 1985). "[A] § 102(b) reference "must sufficiently describe the claimed invention to have placed the public in possession of it." Paperless Accounting, Inc. v. Bay Area Rapid Transit Sys., 804 F.2d 659, 665 (Fed. Cir. 1986), cert. denied, 480 U.S. 933 (1987)(quoting In re Donohue, 766 F.2d at 533). An enabling disclosure is one that allows a person of ordinary skill to practice the technology without undue experimentation based on the guidance in the disclosure along with what is well known in the art. In re Wands, 858 F. 2d 731, 737 (Fed. Cir. 1988).

See also, Ex parte Logan, 38 USPQ2d 1852, 1856 (BPAI 1994) (unpublished). While this Board case is not binding precedent, it is probative of an appropriate analysis under the present facts. In Ex parte Logan, Id., the claims were rejected over a patent and a corresponding patent application. In response to the rejection, appellants argued that the cited patent and application were inoperable. In support of the appellants' assertions, a declaration was presented.

**The Examiner dismissed the declaration as mere opinion by an interested party.** The Board in this case noted that the factual evidence presented in the declaration was probative of the issues. Furthermore, the Examiner did not offer any evidence or argument that the required modifications to make the previous invention functional would have been made by a person of ordinary skill in the art. The board concluded that the appellant had met their burden of rebutting the presumption of operability of the prior art patent by a preponderance of the evidence. Id. In reaching this holding, the court expressly noted that, "**the examiner has failed to shoulder his burden of rebutting the appellant's evidence of non-enablement/inoperability.**" Id. (emphasis added).

D. LEGAL BACKGROUND – DECLARATION REBUTTAL EVIDENCE

Since the present case is on remand from the Federal Circuit, there is law of the case directly on point to this issue, but this law of the case from *In re Kumar* is discussed below in the context of the specific arguments. The use of declaration evidence to establish non-enablement of a patent has been addressed in the case law. "To successfully rebut the examiner's prima facie case of enablement, it was incumbent upon [the applicant] to introduce **affidavits** or other factual evidence in support his position." In re Payne, 203 USPQ 245, 256 (CCPA 1979) (emphasis added). "Facts, such as test data demonstration inoperativeness...or facts set forth in an **affidavit (37 CFR 1.132) of an expert in the field suggesting that inoperativeness, would be highly probative**." Id. (emphasis added). Applicants can rebut a presumption of operability of a reference by showing by a preponderance of the evidence that the reference is inoperable. In re Sasse, 207 USPQ 107, 111 (CCPA 1980) ("He had to rebut the presumption of operability of Guillot [patents] by a preponderance of the evidence."). Declaration evidence is sufficient to rebut the presumption of operability and operates to place the burden back onto the PTO to rebut the contention of non-enablement. Id. at 111-112. Additionally, the CCPA has stated that "we regard the opinions of

experts in the field as entitled to consideration." In re Sebek, 175 USPQ 93, 95 (CCPA 1972). With respect to the weight of expert opinions, the CCPA has stated that:

> The board stated that the Henne affidavit is essentially an opinion and as such carries little weight. It seems to us that one as well qualified in the highly technical art of fluoride-containing halogenated compounds as Henne is shown to be **is properly entitled to express his expert opinions, and that such opinion is entitled to be given consideration** with the other evidence in the case in determining whether the conclusion of obviousness is supported by opinion of the examiner as to what the prior art teaches.

In re Fay, 146 USPQ 47, 51 (CCPA 1965) (emphasis added). Furthermore, MPEP § 716.01(c) indicates that "[opinion] testimony is entitled to consideration and some weight so long as the opinion is not on the ultimate legal conclusion." "In assessing the probative value of an expert opinion, the examiner **must** consider the nature of the matter sought to be established, the strength of any opposing evidence, the interest of the expert in the outcome of the case, and the presence and absence of factual support for the expert's opinion." Id. (Emphasis added). Thus, it is well settled that expert opinions expressed in declarations are entitled to consideration, and that declaration evidence is sufficient to rebut the presumption of operability of a reference.

Moreover, "it is well established that enablement requires that the specification teach those skilled in the art to make and use the invention without undue experimentation." In re Wands, 8 USPQ2d 1400, 1404 (Fed. Cir. 1988). "Whether undue experimentation is needed is not a single, simple factual determination, but rather is a conclusion reached by weighing many factual considerations." Id. Factors to be considered in determining whether a disclosure requires undue experimentation include "(1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims." Id.

A recent Federal Circuit case based on a patent application with overlapping inventors as the present case on appeal has further clarified the issue of Declarations directed to lack of a reasonable expectation of success of the teachings of a reference. "The applicant has the burden of coming forward with evidence in rebuttal, when the prior art includes a method that appears, on its face, to be capable of producing the claimed composition. **This burden may be met by presenting sufficient reason or authority or evidence, one the facts of the case, to show that the prior art method would not produce or would not be expected to produce the claimed subject matter."** In re Kumar, 418 F.3d 1361, 1368 (Fed. Cir. 2005) (emphasis added). "To render a later invention unpatentable for obviousness, the prior art must enable a person of ordinary skill in the field to make and use the later invention. Beckman Instruments, Inc, 892 F.2d at 1551; Payne, 606 F.2d at 314. Thus the relevant inquiry is not whether the Rostoker patent was invalid for lack of enablement, but whether Rostoker enabled persons skilled in the art to produce particles of the size and distribution claimed by Kumar." Id, at 1369.

E. LEGAL BACKGROUND - OBVIOUSNESS-TYPE DOUBLE PATENTING IN POST URUGUAY TRADE PERIOD

The judicially created doctrine of non-statutory double patenting was established to prevent an improper timewise extension of the right to exclude granted by a patent. See, for example, In re Goodman, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); In re Longi, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); In re Van Ornum, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); In re Vogel, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); In re Thorington, 418 F.2d 528, 163 USPQ 644 (CCPA 1969); In re White, 405 F.2d 904, 160 USPQ 417 (CCPA 1969); In re Schneller, 397 F.2d 350, 158 USPQ 210 (CCPA 1968); In re Sarett, 327 F.2d 1005, 140 USPQ 474 (CCPA 1964). All patents issuing from applications filed after June 8, 1995 (six months after the Uruguay trade agreements were implemented in the Uruguay Round

Agreements Act, referred to herein as the post-URAA period) have a patent term of twenty years from their earliest priority date subject to any patent term extension. The changes in patent term affect the application of obviousness-type double patenting since the foundation of obviousness-type double patenting relates to patent term. However, the issues raised herein evidently are ones of first impression in that the U.S. Supreme Court, the U.S. Court of Appeal for the Federal Circuit and the PTO Board of Patent Appeals and Interferences do not seem to have ruled on the subject. In other words, the law and procedures have not been changed to reflect the fundamental changes in patent term. In particular, Applicants assert that a pending patent application with a priority date after June 8, 1995 should not be rejected for obviousness-type double patenting over a later filed application/patent, but if the earlier filed application can be rejected for obviousness-type double patenting over a later filed application/patent, a two way test for obviousness should be applied.

Under the pre-URAA rules, a two way test for obviousness was applied to determine whether or not to reject a pending patent application for obviousness-type double patenting over a patent that was later filed if the applicant could not have filed the claims in a single application and there was administrative delay. Eli Lilly & Co. v. Barr Labs., 251 F.3d 955, 975 (Fed. Cir. 2001); In re Berg, 140 F.3d 1428, 1434 and 1435 (Fed. Cir. 1998). A two way test was similarly mandated in the case of a double patenting rejection over a later filed application not yet issued as a patent, for patent applications in circumstances in which there were administrative delays of the PTO in prosecuting the first filed application and the applicants could not have filed the conflicting claims in an earlier filed application. However, in the pre-URAA period a later filed application that issued before a first filed application expired first since term was based on issue date rather than filing date. This is no longer true unless the first filed application has a patent term extension. Thus, the circumstances are inherently different.

Under the two-way test, the examiner not only asks whether the particular application claims are obvious over the patent claims (or the claims of the later filed application), but the examiner also asks whether the patent claims are obvious over the application claims. In re Berg at 1432. If not, the application claims later may be allowed. Id. The one-way test applies if the application at issue is the later filed application, both applications are filed on the same day, or the applicant could have filed all of its claims in the first application but elected not to. MPEP 804 II.B.1.(a); In re Berg, at 1434. An applicant could have filed all of its claims in one application when the disclosure of the earlier filed application will support the claims in the later filed application. Id. This is consistent with the policy of granting an applicant a patent in exchange for disclosure to the public of all of the information relating to the invention; and thus, preventing an unjustified extension of the patent term by not disclosing all of the developments in one application. However, the two-way test was designed to prevent invalidity for obviousness-type double patenting where the applicants filed first for a basic invention but later for an improvement thereof. Id. at 1432. This is consistent with exchanging a patent for public disclosure of additional developments that were not known at the time of the initial basic invention.

Under the pre-URAA procedure, if the later filed application had not issued, the double patenting rejection is provisional. If the provisional double patenting rejection becomes the only remaining rejection, the double patenting rejection is withdrawn and the case allowed to issue. See MPEP 804 I.B. Of course post-URAA, if the application under consideration is the second filed application, it does not make sense to withdraw the obviousness-type double patenting rejection just because the first filed application has not issued since the second filed application will expire later regardless of when it issues unless there is patent term extension. But if the application under consideration is the first filed application, the provisional rejection does not make any sense in the first instance.

Below Applicants present an analysis of the post-URAA circumstance in view of statutory changes based on analogy with the relevant pre-URAA law summarized above and the new statutory scheme. Applicants conclude that the USPTO and the courts lack the authority to impose a non-statutory double patenting rejection of a previously filed application over a later filed application (or a corresponding issued patent) since such a rejection is contrary to the provisions of the patent term extension legislation. Even if the USPTO has the authority, a two-way obviousness test should be imposed unless the patentee could have presented the claims of the later filed application in the first filed application to be consistent with the judicial framework put into place for pre-URAA patent applications.

In the pre-URAA period, a later filed application that issued before a first filed application expired first. However, this is no longer true because the term of the patent is 20 years from the date of filing unless the first filed application has a patent term extension. 35 U.S.C. § 154. Thus, the post-URAA circumstances relating to term are inherently different. Under the current rules, the length of time an application remains in prosecution simply diminishes the effective length of the patent term accordingly. Id. at 1435, n9. Thus, the prosecution of a first filed application can never be an attempt to extend the term of a later filed application. So in a post-URAA period, the policies underlying an obviousness-type double patenting rejection no longer apply to a patent application based on the later filing of another patent application.

With respect to the requirement of common assignment under a terminal disclaimer, this presumes a proper double patenting rejection. See In re Van Ornum, 214 USPQ 761, 763-767 (CCPA 1982).

ANALYSIS

Rejection under 35 U.S.C. § 102(b)/ 35 U.S.C. § 103(a) - Rostoker

The Examiner rejected claims 1-3, 5-8, and 19-22 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over US Patent 5,389,194 to Rostoker et al. (Rostoker, see Evidence Appendix). This application was previously subject to appeals. In earlier appeals, the rejection of claims 1-3 and 5-22 under 35 U.S.C. § 103(a) as obvious over Rostoker et al. was pending before the BPAI and CAFC, resulting in decisions under Appeal 2001-1031 and Appeal 04-1074, respectively. Although the BPAI affirmed the rejection of claims 1-3, 5-16, and 19-22 over Rostoker, the CAFC has vacated the BPAI's decision and remanded for further consideration. Appellant summarizes the issues as they presently stand in view of the original appeal, claim amendments and further prosecution.

Summary of Results of Earlier Appeal

Two issues were argued before the CAFC. One issue was the futile attempt to understand the teachings of the Rostoker patent, which Applicants still maintain does not disclose their claimed invention. The second issue was Applicants' well supported assertion that the Rostoker patent does not enable the practice of Applicants' claimed invention. The CAFC explicitly stated that the Examiner's legal position regarding Rostoker is "incorrect" and mandated the consideration of the Declarations of both Dr. Singh and Dr. Kambe in resolving the issues.

The Examiner continues to fail to abide by the CAFC's decision. Applicants maintain that the Examiner has fallen short of establishing *prima facie* anticipation or obviousness. To the extent that *prima facie* anticipation or obviousness has been established, these have been clearly rebutted by Applicants. Applicants have shown unrefuted evidence that the Rostoker patent does not teach a process suitable for producing the claimed particle collections. The Declarations of experts Dr. Singh, Dr. Li and Dr. Kambe indicate that other approaches to produce the claimed

particle distributions for these materials are publically available, and the Rostoker patent does not teach any other approach for producing Applicants' claimed particles.

Rejection under 35 U.S.C. § 103(a) – Rostoker in view of Farkas

The Examiner rejected claims 11-16 under 35 U.S.C. § 103(a) as obvious over US Patent 5,389,194 to Rostoker et al. (Rostoker, see Evidence Appendix) in view of US Patent 6,001,730 to Farkas et al. (Farkas, see Evidence Appendix). Appellant maintains that the Examiner has fallen short of establishing *prima facie* obviousness. Appellant has also provided unrefuted evidence relating to patentability by submitting Declarations of Dr. Singh, Dr. Li and Dr. Kambe. The Farkas patent fails to remedy the deficiencies of the Rostoker patent by failing to disclose or suggest submicron aluminum oxide particles in a polishing composition.

Provisional Rejection based on Nonstatutory Obviousness-Type Double Patenting

The Examiner provisionally rejected claims 1-3, 5-8, and 19-22 under nonstatutory obviousness-type double patenting as being unpatentable over all the claims of copending Application No. 09/969,025 ('025, see Evidence Appendix). Appellant maintains that the Examiner has improperly provisionally rejected the claims on grounds of nonstatutory obviousness-type double patenting. First, '025 has a priority date of October 1, 2001, and the instant application has filing date of August 19, 1998. Second, '025 is unrelated to the instant application under 35 U.S.C 120. Third, such a rejection is not proper for applications filed after June 8, 1995 over later filed applications.

Arguments

Appellants maintain that Rostoker fails to disclose particle size distribution in a manner that affords a definite interpretation and does not enable the claimed invention. Appellants have provided Declarations by Dr. Kambe and Dr. Singh to demonstrate that "Q" must be considered in calculating particle size distribution, Rostoker's description of particle size distribution is not

consistent with conventional determination of particle size distribution, and Rostoker does not enable formation of the collection of submicron aluminum oxide particles within the claimed particle size distribution. Although the CAFC has **mandated** under the binding law of the case appropriate consideration of the Declarations of Dr. Kambe and Dr. Singh after the BPAI's failure to do so, the Examiner continues to dismiss them. Furthermore, Applicants have submitted a Declaration by Dr. Li as further support of the proposition that the claimed particle collecitons are not available in the public domain.

Rostoker's Disclosure of Particle Size Distribution is UNCLEAR

In an earlier appeal, the Examiner, BPAI, and Solicitor all had separate interpretations of Rostoker, demonstrating that Rostoker is *ipso facto* unclear. The Examiner adopted the BPAI's *sua sponte* oversimplified calculations of alleged particle distribution considering only variables (i.e. "X," "Y," and "P") while ignoring a significant variable (i.e. "Q") to arrive at the claimed particle distribution. Rostoker discloses that particle size distribution is controlled to within "Y" nm of a particle size of "X" nm, "Y" is approximately "P" percent of "X", and "Q" is inversely related to "Y" and is a measure of the distribution of particle sizes. "P" is preferably less than or equal to 50% to define a narrow (Gaussian) distribution of particle sizes about "X." "P," "Y," and "Q" are unclearly defined and somehow related to particle size distribution. Due to its relationships to "Q" which is explicitly but unintelligible defined, "Y" cannot be so easily defined as the Examiner and the BPAI has indicated. "Y" is also confusing by itself since it is associated with both size (nm) and percentage (%). Rostoker implies that particle size distribution defines a Gaussian curve, but Rostoker's mathematical concoction fails to account for standard deviations from the mean particle size, and confidence intervals, which are necessary components to defining the Gaussian curve. Examiner's use of +/- creates a confidence interval based on a particular probability level, which is not specified. Appellants maintain that particle distribution as disclosed in Rostoker cannot be interpreted in any definite

way. Examiner's rejection is based on ignoring a portion of the discussion in the Rostoker patent and imposing their own interpretation on unclear language without any basis.

To reinforce that "Q" must be factored into Rostoker's particle size distribution calculation and Rostoker's determination of particle size distribution is unconventional, Applicants filed a Declaration under 37 C.F.R. §1.132 by Professor Singh. Despite the fact that the CAFC has agreed that the Board made clear legal errors when they refused to consider Dr. Singh's Declaration, the Examiner has continued to dismiss it without affording it due consideration.

Dr. Singh is an expert who has consulted with many important companies in the field of nanotechnology. The Board acknowledged in another decision of Appeal No. 2001-2242 that "Prof. Singh has impressive credentials and his testimony must be given weight." Opinion at page 13. Applicants note that Professor Singh has no interest to be gained in the present case. Dr. Singh has no equity interest in NanoGram. Any expert will require payment for their time. He is not an inventor and has not consulted for NanoGram in the area of phosphors, except for the Declaration under discussion. Dr. Singh has **no interest** in the outcome of the present patent application.

Having read Rostoker carefully, Dr. Singh concluded that the "distribution as described by Rostoker has several internal inconsistencies" and "does not conform to any standard representation of distribution functions described in standard textbooks and standard references." Dr. Singh noted that "Q is important since Q, in principle, defines the size distribution," but "the discussion of Q is not internally consistent" for various mathematical reasons.

The Examiner rejected Dr. Singh's Declaration, stating that the "declaration criticizes one possible method of determining Q, as defined in the reference and there has been no showing of a preponderance of evidence that the Q value cannot be determined by the disclosed method." With all due respect, the standard for evaluating the teachings of a cited reference is not what is possible if the reference is rewritten from scratch, but what a person of ordinary skill in the art would interpret the subject matter to mean. We all can fix the Rostoker patent to say something

meaningful, but **the issue is what does Rostoker, as written, teach to a person of ordinary skill in the art**? The answer is nothing. It is not the Examiner's role to rewrite Rostoker to make sense while saying something different when rewritten from what it said as published.

Examiner's statement that the "declaration criticizes one possible method of determining Q" appears to subscribe to the fact that Rostoker's Q could be determined by numerous methods, indicating that Rostoker is vague and ambiguous at best. Examiner cannot add to the disclosure (e.g. using one method of calculating Q when Rostoker does not give any guidance to calculating Q and there are many possible methods of calculating Q) or use only parts of the disclosure while ignoring others. Despite the fact that it is uncertain exactly how Q and Y factors into the particle size distribution, the Examiner appears to manipulate variables described in Rostoker by choosing to use some (i.e. X, Y) while ignoring others (i.e. Q) to arrive at the claimed invention, and this is improper.

Furthermore, the Examiner asserts that "the fact that the method for determining Q might be unclear to Dr. Singh and not found in the books cited by Dr. Singh does not detract from the rest of the teachings of this patent nor does it show the Q value cannot be determined by one of ordinary skill in the art." However, Professor Singh stated in the declaration that he had read the Rostoker patent carefully. That would indicate the whole patent. The Examiner does not seem to question that Dr. Singh is an expert in the field. The Examiner seems to be asserting that he and the Board are persons of ordinary skill in the art, which has not been established, and that they know better than an expert. The Examiner's unsupported assertions simply and clearly do not overcome the Declaration testimony of an expert.

Neither the Examiner nor the Board have described the skill level of a person of ordinary skill in the art. With all due respect, the Examiner's position seems to be that Professor Singh as an expert is too smart to be able to interpret the language in the Rostoker patent. If he were only a little less of an expert then maybe it would all be clear to him. But if the Examiner's position

has **any support** in the field, there should be some documentary evidence available to present in support of the Examiner's position, but none has been presented. Applicants have shown far beyond preponderance of the evidence and have presented clear and convincing evidence that the Rostoker patent does not teach particles with Applicants' claimed particle size distribution. **The rejection cannot stand unless the Examiner or the Board presents some further evidence that is supportable.**

Rostoker FAILS to Enable the Claimed Invention

Rostoker discloses the use of the Siegel method to produce the Rostoker composition, and Appellants presented clear rebuttal evidence through the Declarations of Dr. Singh, Dr. Kambe, and Dr. Li that Rostoker does not enable the claimed invention by using the Siegel method. An article and a patent by Siegel disclosing his process have also been attached. Siegel's article discloses production of fused titanium dioxide particles. When the Siegel process is used to form aluminum oxide particles, the particles do not result in the claimed invention. A copy of a transmission electron micrograph of delta-aluminum oxide particles made through the Siegel process has been attached in the Siegel references.

In response, the Examiner stated that Rostoker does not disclose that the only method of making the aluminum oxide particles used in the claimed invention is by the method disclosed in the Siegel patent and that Rostoker merely references the Siegel patent as one known method for controllably producing the ultrafine-grained or nanocrystalline materials. Examiner also stated that Applicants' arguments are directed to process limitations when the claims are directed to compositions.

The Examiner has mistakenly placed the burden on Applicants that there is no known way in the art to practice Applicants' claimed invention. This burden is the Examiner's and not Applicants'. It is only **Applicants' burden** to establish by a preponderance of the evidence that the disclosure in the Rostoker patent does not **enable** one of ordinary skill in the art to practice

Applicants' claimed invention. But Applicants have more than adequately met their burden and the requirement of a higher burden is an error of law. However, Applicants have even met the higher standard applied by the Examiner through the Declaration of Dr. Li.

The Rostoker patent only explicitly refers to the Siegel patent as a source for ultrafine powders. In the earlier appeal, the Board and the Examiner noted (see Decision at page 4) that the Rostoker patent does not state that the only method of making the particles is by the method of Siegel. **While the Rostoker patent does not indicate that the Siegel method is the only way of making the particles, the mere suggestion that it is not limited to the Siegel method is not the equivalent of enabling disclosure.** It is the Rostoker patent that must be enabling, not some unspecified other way of making the particles.

Applicants' have presented **un-rebutted** evidence that the Siegel patent does not enable the practice of Applicants' claimed invention, including Declarations by Dr. Singh, Dr. Kambe, and Dr. Li along with documentary evidence that the Siegel process cited in the Rostoker patent is not capable of producing the claimed particle collections. Dr. Singh observed that "[t]he only source of powders described in the Rostoker '081 patent is the process described in the Siegel patent," which "does NOT describe the formation of submicron particles." Dr. Singh further stated that "I am aware of no approaches for the formation of silica particles as claimed." Dr. Kambe stated that "[s]ince the approaches described in the cited patents are not capable of producing nanoparticles with narrow particle size distributions, a person of ordinary skill in the art would not have thought, as of our filing date, that the claimed collections of particle would be obvious over the[m]." Dr. Kambe also stated that he is aware of no methods other than that described in the present application for producing the aluminum oxide nanoparticles with average particle size less than about 500 nm within the narrow particle size distribution as claimed. Having researched literature and commercial aluminum oxide powders, Dr. Li found that the most relevant articles and supply of aluminum oxide powders he discovered failed to be

within the claimed narrow particle size distribution. These Declarations provide overwhelming evidence that Rostoker fails to enable the claimed invention.

The Examiner does not seem to question this rebuttal evidence. **The only other possible source of enablement in the Rostoker patent** is the mere suggestion that there may be other **unspecified** ways of obtaining the particles. **The implication that there may be other unspecified ways of making the particles can only be enabling disclosure if the unspecified ways are known to a person of ordinary skill in the art.** A person of ordinary skill in the art would need to exert at least undue experimentation unless the skilled artisan knows how to make or obtain the claimed particles without any further guidance since Rostoker does not provide any guidance.

**Since the issue is whether or not a person of ordinary skill in the art would know of a way of making or obtaining the claimed particles without any guidance, Dr. Singh's, Dr. Kambe's, and Dr. Li's Declarations are all directly on point.** Dr. Singh, Dr. Kambe, Dr. Li are certainly persons with at least ordinary skill in the art. They all have considerable experience in nanoparticles. For example, Dr. Kambe was selected by the International Center for Materials Research to lead an effort for the production of ultrafine particles based on laser pyrolysis. Dr. Kambe's experiences built on his extensive technical experiences as a senior scientist at NTT in Japan and his Ph.D. from MIT. All the Declarations directly addressed that a person of ordinary skill in the art could not practice Applicants' claimed invention based on the meager disclosure in the Rostoker patent. **Nothing more was needed to be shown.** The meager disclosure in the Rostoker patent provided little for Dr. Singh, Dr. Kambe, and Dr. Li to refute in their Declarations. Applicants' burden with respect to refuting enablement is lower not higher because the guidance provided by Rostoker was nonexistent. To make Applicants' burden higher because the Rostoker patent provides no guidance on the production of the claimed particles is unreasonable and contrary to the law.

The Examiner's implied assertion that Applicants must provide evidence of more with respect to showing that there is no other way of making Applicants' claimed invention is a shifting of burdens contrary to the law. **Applicants' simply do not as a matter of law have the burden to prove patentability** if the Rostoker patent only suggests that there may be some unspecified way of making Applicants' claimed invention. Applicants' have clearly rebutted the enablement of the Rostoker patent by preponderance of the evidence. If a person of ordinary skill in the art could practice the claimed invention without undue experimentation based on the disclosure in the Rostoker patent, the Examiner should easily be able to support that assertion with some kind of evidence. The Examiner has presented no evidence to support the enablement of the Rostoker patent with respect to Applicants' claimed invention. **The Examiner have not given any hints of how the Rostoker patent is enabling. Applicants have overwhelmingly met their burden, and the rejection should be withdrawn.**

In particular, Dr. Kambe stated under oath that he is "very familiar with various approaches for producing nanoscale particles, characterizing these particles and the public availability of nanoscale particles with various properties. A successful founder of a technology driven company working in the area of nanoparticles is required to have such knowledge. Dr. Kambe's resume clearly establishes him as an expert in the field of nanotechnology. An expert is defined by Merriam Webster's 10th Collegiate Dictionary as "one with special skill or **knowledge** representing mastery of a particular subject." Dr. Kambe has said under oath that he has this special knowledge of the field, so that his opinions are irrefutably based on facts, i.e. his knowledge and experience. The statement of an expert is generally considered the best source of facts available. Dr. Kambe stated under oath that he was aware of no method for making the claimed particle collections. This statement alone supports well beyond a preponderance of the evidence that the Rostoker patent is NOT enabling to make Applicants' claimed invention. Yet, Applicants have provided considerable additional evidence.

As stated by the **Federal Circuit** at page 12 of their opinion that remanded the present case back to the PTO (emphasis added), "The PTO argues that as long as Rostoker enables the Rostoker invention, Rostoker renders the Kumar invention obvious, even if Kumar shows that Rostoker does not enable the Kumar invention. **That is incorrect**. To render a later invention unpatentable for obviousness, the prior art must enable a person of ordinary skill in the field to make and use the later invention. Beckman Instruments, Inc., 892 F.2d at 1551; Payne, 606 F.2d at 314. Thus the relevant inquiry is not whether the Rostoker patent was invalid for lack of enablement, but **whether Rostoker enabled persons skilled in the art to produce particles of the size and distribution claimed by Kumar**." The court further indicated that Dr. Kambe's Declaration **needed** to be reevaluated in view of Dr. Singh's Declaration. The Examiner has **not** done this even though the Federal Circuit indicated that it **must be done**. The Federal Circuit's mandates are controlling law of this case. During prosecution, Applicants have also submitted the Declaration of Dr. Li, which further substantiates the Declarations made by Dr. Singh and Dr. Kambe. Copies of the Singh, Kambe, and Li Declarations are attached.

Examiner also stated that Applicants' arguments are directed to process limitations when the claims are directed to compositions. The proposition is well established that the cited art only renders a composition of matter or apparatus unpatentable to the extent that the cited art enables the disputed claims, in other words, if the cited art provides a means of obtaining the claimed composition or apparatus. Assertions in a prior art reference do not support an anticipation or obviousness rejection unless the references place the claimed invention in the hands of the public. Beckman Instruments Inc. v. LKB Produkter AB, 13 USPQ2d 1301, 1304 (Fed. Cir. 1989). The decision from the Federal Circuit for the present application stated that "the prior art must enable a person of ordinary skill to make and use the invention." Opinion at 10-11. The Federal Circuit also stated that the Applicants has the burden to come forward with evidence in rebuttal "when the prior art includes a method that appears, on its face to be capable of producing

the claimed composition" and "sufficient reason or authority or evidence, on the facts of the case, to show that the prior art method would not produce or would not be expected to produce the claimed subject matter." Opinion at 11.

The Examiner appears to overlook the central issue by focusing entirely on what statutory class the claim is directed to and ignoring the law. The fact that the claims are directed to compositions means Applicants are entitled to show that the process disclosed in the cited art does not produce the claimed composition. The courts have mandated that Applicants can produce evidence to show that the process described in the cited art simply cannot, would not, or would not be expected to produce the claimed composition. Through sufficient reason, authority, and evidence as provided by Declarations of experts Dr. Singh, Dr. Li, and Dr. Kambe and documentary evidence, Appellants have clearly met their burden in showing that the Rostoker would not produce the claimed composition well beyond the level of a preponderance of the evidence since none of this evidence has been refuted in any way by the Examiner.

In summary, Applicants have shown un-refuted evidence that the Siegel process does not teach a process suitable for producing the claimed particle collections. In addition, two declarations by experts indicate that they know of no other approaches to produce the claimed particle distributions for these materials. The Rostoker patent does not teach any other approach for producing the particles.

Farkas FAILS to Remedy the Deficiencies of Rostoker

Appellant maintains that the Examiner has fallen short of establishing *prima facie* obviousness by rejecting claims 11-16 over Rostoker in view of Farkas. To overcome Rostoker, Appellant has provided unrefuted evidence relating to patentability by submitting Declarations of Dr. Singh, Dr. Li and Dr. Kambe. The Farkas patent fails to remedy the deficiencies of the Rostoker patent by failing to disclose or suggest submicron aluminum oxide particles in a polishing composition.

Nonstatutory Obviousness-Type Double Patenting Rejection is IMPROPER

Appellant maintains that the Examiner has improperly provisionally rejected claims 1-3, 5-8, and 19-22 over Application No. 09/969,025 on grounds of nonstatutory obviousness-type double patenting. First, '025 has a priority date of October 1, 2001, and the instant application has filing date of August 19, 1998. Second, '025 is unrelated to the instant application under 35 U.S.C 120. Third, such a rejection is not proper for applications filed after June 8, 1995 over later filed applications.

Applicants maintain that the rejection for obviousness-type double patenting over a later filed application is not appropriate. Since an earlier filed patent application cannot be a way to extend the patent term of a later filed application, the earlier filed application should not be subjected to an obviousness-type double patenting rejection. Applicants note that practitioners do not generally file terminal disclaimers for earlier filed applications or patent when later filed improvement applications are filed. Yet, under the reasoning of the pending rejections, all of these earlier patents, which likely would be a majority of all unexpired issued patents, would be unenforceable until a terminal disclaimer is filed over later improvement patents since obviousness-type double patenting is not a doctrine that has limited application within Patent Office practice. Under the Examiner's theory, most patents would be unenforceable since companies do not go back and file terminal disclaimers for all of their old patents when they file later improvement applications, and most older patents would be invalid whenever there was a later filed improvement patent application by the same company, which is very often the case. Thus, this is not a viable legal theory and was never the intent of the judicial doctrine.

Since there is an absence of case law on point, it is useful to review the slight post-GATT revisions to patent office practice. MPEP 804.02 VI., which discusses the Requirement of a Terminal Disclaimer for applications filed on or after June 8, 1995, relates to continuation, divisional or national phase applications under 35 U.S.C. §§ 120, 121 or 365(c). This section of

the MPEP is not applicable to the present fact situation since the two applications are not related through priority claims. The presence of this discussion in the MPEP relating to continuation and divisional applications tends to suggest that the present rejection is improper since the present applications are not related under 35 U.S.C. 120, 121 or 365(c). The negative implication of this MPEP section is that obviousness-type double patent would not be expected to apply based on later filed patent applications.

With all due respect, the Examiner misapplied a judicial doctrine applicable under pre-URAA law in situations following URAA modifications of patent term. The MPEP has not been appropriately modified in view of the changes in patent term. The filing of a non-obvious improvement patent application does not convert the first filled patent application into a way to extend the term of the later filed improvement patent. A patent applicant should not be punished for the patenting of improvements by the requirement of filing a terminal disclaimer that imposes a common ownership requirement. In addition, where does this requirement end? It is certainly now not the practice of filing terminal disclaimers for issued patents for every later filed improvement patent. Typically, the claims of the pioneering patent are obvious over the claims of an improvement patent. Thus, a patent would need to be terminally disclaimed over improvement patents that issue 10, 15 up to 20 years after its filing date.

Furthermore, the second filed application has not issued as a patent. The obviousness-type double patenting rejection is provisional. Under patent office procedure, the provisional double patenting rejection should not prevent issuance of the patent, see MPEP 804 (I)(B). By analogy with the pre-URAA analysis, the Examiner has not asserted a proper provisional rejection since it must involve a two-way test under MPEP guidelines. Also, **requiring less than a two-way test would yield an unfair result.** If a later invention is filed on a non-obvious improvement, a patentee should not be required to file a terminal disclaimer for the broader parent invention based on the filing of the non-obvious improvement patent. This requirement

would discourage the invention and patenting of non-obvious improvements. Such a result is not reasonable nor was this the intention of Congress by the imposition of patent term extension.

In the pre-URAA situation, patent term was based on the issue date of a patent such that delays in prosecution were addressed by the reference point of the patent term. Under the present statute, if the first filed patent is delayed and obtains a term extended beyond the expiration of the later filed patent, this is analogous to the pre-URAA situation of MPEP II(B)(1)(b), in which the "issued patent" (i.e., the earlier expiring patent) is the later filed application. For these situations, a two-way obviousness test was required and still is required with respect to pre-URAA applications. If the claims of the later filed application are not obvious over the claims of the earlier filed patent application, the term of the second filed application is not being improperly extended by the patent term extension of the first filed application, and the double patenting rejection is improper.

In the post-URAA, the only possible justification for an obviousness-type double patenting rejection of an application with an earlier priority date over an application with a later priority date is the term extension of the earlier application. However, the double patenting rejection negates the patent term extension contrary to the statute. Congress enacted the post-URAA patent term extension to account for patent term in the event of delays in prosecution in the patent office. The statute at 35 U.S.C. 154(b) provides for patent term extension.

Patent term extensions were designed by Congress to address delays in prosecution of a patent application in the Patent Office. Application of the double patenting rules, as suggested by the Examiner, would be contrary to the express language of the statue and the purpose of the patent term extension. The judicial doctrine of obviousness-type double patenting was long established when the present form of patent term adjustment was enacted by Congress. Since 35 U.S.C. 154 does not limit patent term adjustment, we can assume that Congress intended to overturn obviousness-type double patenting directed explicitly to limiting patent term

adjustment. Neither the Patent Office nor the courts have the authority to circumvent statutory mandates. The statute could have been drafted by Congress to impose the double patenting limitation on the patent term adjustment, but was not. Therefore, even the use of a obvousness-type double patenting rejection is not allowed by statute to eliminate a statutory patent term adjustment.

Congress did not provide in the statute for the diminution of the extension due to the filing of a later application, which is the direct and only effect of imposing an obviousness-type double patenting rejection on a patent application with an earlier priority dated over an application with a later priority date. Since Congress did not provide for attenuation of the mandated patent term extension under the long established principle of obviousness-type double patenting, the courts and the Patent Office do not have the authority to undermine the Congressionally granted patent term extension. Imposition of an obviousness-type double patenting rejection just to reduce the statutory patent term extension should be an issue for Congress. Furthermore, a patent term extension based on Food and Drug Administration approval under 35 U.S.C. 155 has never been suggested to be a basis for an obviousness-type double patenting rejection.

Under post-URAA patent term rules, an application with a later priority date expires later than a patent application with an earlier priority date unless there is an appropriately long patent term extension of the earlier patent application. Thus, without a patent term extension, the situation is analogous to the pre-URAA situation in which the later filed application issued first such that it had a later expiration date, **which did not result in an obviousness-type double patenting rejection of the first application over the later application**. See MPEP 804. An obviousness-type double patenting rejection of an earlier priority application over a later priority application is only reasonable (if ever) if the earlier application has an **actual** patent term extension such that it expires later than the later application.

Assuming Arguendo the courts and the Patent Office do have the statutory authority to impose an obviousness-type double patenting rejection of an application with an earlier priority date over an application, it can only be imposed after a determination is made that a patent term extension will extend the term of the application beyond the term of the application with the later priority date. Then, the obviousness-type double patenting rejection must be applied with due notice to the judicial framework imposed under pre-URAA law for an earlier filed application rejected for double patenting over a later filed patent/application. In particular, the existence of a patent term extension under 35 U.S.C. 154 indicates that a delay has already been caused by the Patent Office, as officially recognized by statute. Thus, unless the applicant could have filed the claims in the application with the earlier filing date, a two-way obviousness test must be used to determine whether or not an obviousness-type double patenting rejection is proper. The Examiner did not determine that a term extension would extend the term of the present application beyond the term of the later filed applications, and the Examiner did not use a two-way obviousness test. Thus, even assuming Arguendo that the Patent Office has authority to undermine the patent term extension provisions imposed by Congress, the rejection was not properly based on the presence of an appropriate patent term extension and on a two-way obviousness evaluation. Therefore, the rejection is improper and should be withdrawn.

In summary, the only possible rational to impose a double patenting rejection based on a later filed patent/application is the extension of the term of the first filed patent. However, the courts and the Patent Office do not have statutory authority to contravene the extension of patent term through requiring a Terminal Disclaimer. If the authority is present Arguendo, a two-way test should be used unless the later filed claims could have been filed in the earlier application. Even then, it is only proper if there is an actual patent term extension. Since the claims of the '025 application are not obvious over the pending claims of the present application, the obviousness-type double patenting rejection should be withdrawn.

## CONCLUSIONS

Appellant submits that the pending claims are not rendered prima facie anticipated by or rendered obvious over the combined teachings of the cited references, which do not provide a clear interpretation of particle size distribution. To the extent that *prima facie* anticipation or obviousness has been established, this has been clearly refuted by Applicants. Together, the Declarations by Dr. Singh, Dr. Li and Dr. Kambe and literature on Siegel's process provide overwhelming objective evidence from experts with considerable experience in nanotechnolgy that the Rostoker approach will not work to produce the particles disclosed and claimed by Appellant. Certainly, Appellant has presented clear evidence that the Rostoker patent does not enable the claimed invention.

Applicants believe that the Patent Office has failed to meet their burden of persuasion with respect to unpatentability of any of the claims on the present record. Thus, Appellant respectfully requests the reversal of the rejections of claims 1-3, 5-8, 11-16, and 19-22.

Respectfully submitted,

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CLAIMS APPENDIX

1. A collection of particles comprising aluminum oxide, the collection of particles having an average diameter of primary particles from about 5 nm to about 500 nm and less than about one in $10^6$ particles have a diameter greater than about three times the average diameter of the collection of particles.

2. The collection of particles of claim 1 wherein the collection of particles have an average diameter from about 5 nm to about 25 nm.

3. The collection of particles of claim 1 wherein the aluminum oxide has a crystalline structure of $\gamma$-$Al_2O_3$.

4. (Canceled)

5. The collection of particles of claim 1 wherein the collection of particles includes less than about one in $10^6$ particles with a diameter greater than about two times the average diameter.

6. The collection of particles of claim 1 wherein the collection of particles have a distribution of particle sizes such that at least about 95 percent of the particles have a diameter greater than about 40 percent of the average diameter and less than about 160 percent of the average diameter.

7. The collection of particles of claim 1 wherein the collection of particles have a distribution of particle sizes such that at least about 95 percent of the particles have a

diameter greater than about 60 percent of the average diameter and less than about 140 percent of the average diameter.

8. The collection of particles of claim 1 wherein the collection of particles have a distribution of particle sizes such that at least about 99 percent of the particles have a diameter greater than about 40 percent of the average diameter and less than about 160 percent of the average diameter.

9. (Canceled)

10. (Canceled)

11. A polishing composition comprising the particle collection of claim 1 wherein the polishing composition comprises from about 0.05 percent by weight to about 15 percent by weight aluminum oxide particles.

12. The polishing composition of claim 11 wherein the polishing composition comprises from about 1.0 percent by weight to about 10 percent by weight aluminum oxide particles.

13. The polishing composition of claim 11 wherein the dispersion is an aqueous dispersion.

14. The polishing composition of claim 11 wherein the dispersion is a nonaqueous dispersion.

15. The polishing composition of claim 11 further comprising abrasive particles comprising silicon carbide, metal oxides other than aluminum oxide, metal sulfides or metal carbides.

16. The polishing composition of claim 11 further comprising colloidal silica.

17. (Allowed) A method for producing a collection of aluminum oxide particles having an average diameter from about 5 nm to about 500 nm, the method comprising:

flowing a molecular stream through a reaction chamber, the molecular stream comprising an aluminum precursor, an oxidizing agent, and an infrared absorber; and

pyrolyzing the flowing molecular stream in a reaction chamber, where the pyrolysis is driven by heat absorbed from a continuous wave laser beam.

18. (Allowed) The method of claim 17 wherein the aluminum oxide particles have an average diameter from about 5 nm to about 100 nm.

19. A collection of particles comprising aluminum oxide, the collection of particles having an average diameter from about 5 nm to about 500 nm and a distribution of particle sizes such that at least about 95 percent of the particles have a diameter greater than about 40 percent of the average diameter and less than about 160 percent of the average diameter.

20. The collection of particles of claim 19 wherein the aluminum oxide has a crystalline structure of $\gamma$-$Al_2O_3$.

21. The collection of particles of claim 19 wherein the collection of particles have a distribution of particle sizes such that at least about 99 percent of the particles have a

diameter greater than about 40 percent of the average diameter and less than about 160 percent of the average diameter.

22. The collection of particles of claim 19 wherein the collection of particles have a distribution of particle sizes such that at least about 95 percent of the particles have a diameter greater than about 60 percent of the average diameter and less than about 140 percent of the average diameter.

EVIDENCE APPENDIX

1. U.S. Patent 5,389,194 to Rostoker et al.

EVIDENCE APPENDIX

3. Application Serial No. 09/969,025

# EVIDENCE APPENDIX

4. Section 132 Declaration of Professor Singh

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

| | | |
|---|---|---|
| Applicant : Kumar et al. | | |
| Applic No.: 09/085,514 | | |
| Filed : May 27, 1998 | | Group Art Unit: 1773 |
| For : SILICON OXIDE PARTICLES | | Examiner: K. Bernatz |
| Docket No.: 2950.02US01 | | |

## DECLARATION UNDER 37 C.F.R. § 1.132

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

I, Rajiv K. Singh, Ph.D., hereby declare as follows:

1. I am presently a Professor of Material Science and Engineering at the University of Florida at Gainesville. Apart from my academic responsibilities, I provide consulting services through R. K. Singh Consulting Inc.

2. I received my Ph.D. degree in 1989 in Material Science and Engineering from North Carolina State University, Raleigh, NC.

3. I have been on the faculty at the University of Florida since 1990. I was promoted to Associate Professor with tenure in 1995 and to full Professor in 1997. A copy of my Curriculum Vitae is attached.

4. My recent accomplishments include receiving a National Science Foundation Young Investigator Award in 1994 and the Hardy Gold Metal for Outstanding Contributions in Material Science in

1995. I was a Distinguished Visiting Professor/Scientist at National University of Singapore (1999) and National Institute for Materials and Chemical Research, Tsukuba, Japan (2000). I am a fellow of the American Society for Materials (ASM). I am the author or co-author of more than 300 scientific articles and conference proceedings. I have co-edited seven books and guest edited five journal issues.

5. I have organized over 15 international conferences in advanced processing of materials including nano-particle science and technology and chemical- mechanical polishing (CMP).

6. I have been the Associate Director of the Engineering Research Center for Particle Science and Technology, at the University of Florida from 1994 -2001. My prime responsibility at this position was to develop advanced techniques for characterization of particles.

7. I am under a Consulting Agreement with NanoGram Corporation to provide consulting services in the area of chemical-mechanical planarization. I am not a shareholder in NanoGram Corporation. Also, I have no interest in the present patent application.

8. I have been working in the area of surface polishing and material science relating to properties of inorganic particles for many years. My laboratory at the University of Florida has performed extensive experiments in particle properties and in surface polishing.

9. I have read carefully U.S. Patent 5,128,081 to Rostoker, U.S. Patent 5,128,281 to Siegel et al., U.S. Patent 5,846,310 to Noguchi et al., U.S. Patent 4,775,520 to Unger et

al., and a passage from Ullmann's Encyclopedia of Industrial Chemistry, Vol. A23 at pp. 635-639. In addition, I have read the pending claims of the above noted patent application entitled "SILICON OXIDE PARTICLES." I did not participate in any capacity with the preparation of the SILICON OXIDE PARTICLES patent application.

10. With respect to the Rostoker '081 patent, a theoretical type of distribution is described in the patent. This distribution as described by Rostoker has several internal inconsistencies, as described below. Additionally, this distribution described by Rostoker does not conform to any standard representation of distribution functions described in standard textbooks and standard references.

In the Rostoker distribution, X is the average particle size. Y relates to a range around X. However, Q is important since Q, in principle, defines the size distribution. Unfortunately, the discussion of Q is not internally consistent. Q is indicated in the patent to be a dimensionless quantity. Q is defined as the concentration of particles at "X" divided by a concentration of particles in a range 3dB lower than "X". The numerator of this expression has units of $\#/cm^3$, whereas the denominator term denoted by concentration of particles in a range of sizes 3dB below X has units of $\#/cm^2$. Thus, according to Rostoker's definition, Q is not dimensionless but has units of 1/cm or 1/length. For Q to be a dimensionless quantity, either both the quantities should be defined in a certain range (e.g., concentration range +1dB of X divided by concentration at range +1dB at X/2), or both the quantities should describe the concentration at specific values (e.g., at X and at 3dB below X).

Even if we assume that the patent described Q as ratios at concentrations at X and at 3dB below X (which is not the case

in the patent description), which makes Q dimensionless, there are several more inconsistencies. First, the particle size distribution is defined by only two points, which can be extrapolated into any distribution one might choose to elect. Secondly, if we define A as the point at which the concentration of particles in a range 3bd below x, then the concentration at A equals concentration at $X/10^{0.3}$. Then the concentration at A corresponds approximately to the concentration at X divided by 2. This value does not correspond to a Gaussian distribution, and the evaluation of A does not address the problems with the definition of Q. The Rostoker patent nowhere describes a 3 sigma (standard deviation) distribution. Also, the standard deviation cannot be defined for a distribution given in the patent.

It should be noted that the particle size distribution, as described in the Rostoker patent is not consistent with the particle size distributions that are frequently used in the standard particle size and technology books and publications. Examples of some of the standard book publications with which I am familiar are 1) A. Jillaventesa, S. Dapkunas and L.H. Lum, "Particle Size Characterization," NIST Recommended Practice Guide, NIST Special Publication, 960-1 (2001); 2) T. Allen, "Particle Size Measurement," 4th Edition, Chapman and Hall, London (1992); 3) B. H. Kaye and R. Trottier, Chemical Engineering, 99:84 (April 1995); 4) R. J. Hunter, "Foundations of Colloidal Science," Wiley (1998); 5) E. Kissa, "Dispersions, Characterization Testing and Measurement," and 6) B. V. Miller and R. Lines, CRC Critical Reviews in Analytical Chemistry, 20:75-116 (1988). Relevant pages from Reference 4 are attached.

The only source of powders described in the Rostoker '081 patent is the process described in the Siegel patent. However, the Siegel patent only describes the formation of nanocrystalline materials. In other words, the materials are polycrystalline materials with nanocrystalline domains. The

Siegel patent does NOT describe the formation of submicron particles. Furthermore, I am aware of no approaches for the formation of silica particles as claimed by NanoGram except for the NanoGram process, as described further below.

11. With respect to the Unger '520 patent, this patent describes the formation of a silica gel using a two-step process. I have considerable experience with reactions that form silica gels including the Stober process and processes similar to the Unger process, from work that has been performed in my lab in Gainesville. Also, the process that leads to the formation of silica particles from alkoxide precursors is well documented in the literature, such as the texts Sol Gel Science, by C. Jeffrey Brinker and G. Scherer, Academic Press (1990) and The Chemistry of Silica, by R. K. Iler, Wiley (1979). The first step in the Unger process uses the Stober process to form a silica gel.

In the second step, increasing the particle size and removal of the porosity further refines the sol. In both the Stober and Unger processes, the hydrolysis of the alkoxide precursors occurs in basic conditions leading to formation of sol as a result of hydrolysis, polymerization and condensation reactions. The sol particle in this process typically consists of partially coalesced small clusters that form porous structures. The clusters typically are made of trimers and tetramers of silicon-hydrogen-oxygen precursors such as $SiO(OH)_3$, $SiO_2(OH)_2$, $Si_4O_6(OH)_6$, $Si_4O_8(OH)_4$, etc. After the condensation process, the clusters contain a large number of silanol groups and siloxane bonds. Several workers have made extensive studies on the use of FTIR, NMR and Raman Spectroscopy to understand the formation of the particles. Articles by Lippert et al. and Zerda et. al. are attached.

The cluster-like <u>aggregates</u> making the sol particles are typically smaller than 50 nm, and have a high surface area due to formation of the porous structures. Because of the high

porosity the surface area of the sols are much larger than the theoretical calculated surface area. The Unger patent also shows that the surface area of the sols of 100 - 350 $m^2$/gm, which is typically nearly two orders of magnitude greater the theoretically calculated surface areas based on the size of the particle measured by standard techniques such as TEM, and light diffraction measurements. Thus the sols are chemically and structurally different from a non-porous silica particle which is typically obtained from the Nanogram process. Specifically, the sols may have significant chemical variation than silicon dioxides, and the aggregates do not have the uniformity described in the NanoGram claims.

12. With respect to the Noguchi patent, this patent describes the application of a coating onto the silica gel of the Unger patent. The Noguchi patent does not deal with the synthesis of silica particles.

13. Pyrolytic or flame produced process is a standard method to make small particles of silica, alumina, titania, etc. There are several references that show the details on the flame-produced process. Examples include 1) Ulmann's encyclopedia; 2) Ulrich, Combustion Science Tech. 4:47-57 (1971); 3) G. W. Scherer in Better Ceramics Through Chemistry, eds. C. J. Brinker et al. (North Holland, NY 1984); 4) D. W. Schaefer, Material Research Society Bulletin, 13:22-27 (1988); 5) J.E. Martin et al., Phys. Rev. A 33:3540-3543 (1986); 6) A. J. Hurd et al., Phys. Rev. A 35:2361-2364 (1987); 7) J. D. F. Ramsay, Colloidal Surfaces 18:207-221 (1986). Copies of References 2, 5 and 6 are attached for reference. In the flame oxidation process, the small particles, which are formed by the oxidation reaction initially aggregate with each other by a ballistic process which mean that the mean free path of the aggregating species is large, compared

to the cluster size. In the second phase of the growth process, once the particles are large compared to the mean free path the trajectories of the particles change from ballistic to Brownian motion. The meandering path of the Brownian motion encourages attachment of the incoming cluster to the target periphery reacting aggregates and ramified fractal structures. Standard techniques such as visible light scattering and small angle neutron scattering have been used to show that the fractal dimension of the particles is characteristic of the diffusion limited cluster aggregation. Depending on the residence time and reactor design, the size of the primary particles may vary from 20 nm to 200 nm.

Although the primary particle size of the pyrolytic silica can be small, the particles form hard aggregates that neck in the aggregates, which make them difficult to disperse. The neck formation has been determined from transmission electron micrography (TEM). Attempts to disperse these particles result in dispersion of clusters of the fused aggregates forming individual particles. There is no way to separate the fused aggregates because the fusing results in hard bonding. Workers in field unfortunately refer to the grains that are fused together as primary particles, even though the hard fusing of these grains prevents separation of the grains as distinct particles. The actual particles are the fused entities or cluster rather than the individual grains. Thus, the particles are very non-uniform even if they are formed from fused grains that may be relatively uniform.

As further support for observations from my direct experience, I have attached a TEM micrograph from my lab that provide documentary evidence of these materials formed by the process described in Ullmann's Encyclopedia. The particle have an average particle size of about 20 - 50 nm and cluster sizes on average of about 250 nm. Due to the hard fusing of these

particles, the aggregates do not have high uniformity.

14. In my experiences, I have not seen materials comparable to the materials claimed in the NanoGram patent application. Based on my extensive experience with surface polishing, I expect that the NanoGram materials will be very good materials for surface polishing since the performance is expected to depend on the uniformity of the polishing materials. Thus, the NanoGram silica particles fill a void in the types of materials available for surface polishing. While NanoGram has not commercially exploited their silica materials for surface polishing yet due to their efforts with other commercial activities, I expect that these materials will someday have a significant commercial role in improving surface polishing of substrates.

14. I declare that all statements made herein that are of my own knowledge are true and that all statements that are made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: Dec. 10 '01

By: Raj K. Singh

Rajiv K. Singh, Ph.D.

CERTIFICATE OF EXPRESS MAIL

"Express Mail" mailing label number EV 011652515 US. Date of Deposit: December 12, 2001. I hereby certify that this paper is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Box AF, Washington, DC 20231.

Glenda Anderson
Name of Person Making Deposit

Glenda Anderson
Signature

# Summary of Accomplishments

- Research Experience, Positions held and Awards
- Management & Leadership
- Research, Education & Outreach
- Overview of Research Programs
- Research Acomplishments & Milestones
- Selected Publications

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**Research Interests and Experience**
Innovative processing of materials; Chemical Mecahnical Planarization (CMP); Semiconductor Integration; Laser processing; Oxide thin films; Transient thermal phenomena; Superconducting and dielectric (low K and high K) thin films; Flat-Panel Displays and Phosphors; Nano Medical Devices; Diamond and related materials, Rapid thermal processing of elemental and wide band gap semiconductors; Nano particles and Particulate coatings; Modeling of transient thermal processing; Angstrom scale advanced materials characterization, Gallium nitride and diamond crystal growth, Front and back end semiconductor cleaning, Thin film batteries; Sustained Drug Release Systems; BioMEMS;

**Education**

Ph.D. Materials Science and Engineering, North Carolina State University, Raleigh, 1989
M.S. Materials Science and Engineering, North Carolina State University, Raleigh, 1987
B.S. Chemical Engineering, Jadavpur University, Calcutta, India, 1985

**Academic Positions**

97-pre Professor, Materials Sci. and Engr., University of Florida, Gainesville, Florida
95-96 Associate Professor, Materials Sci. and Engr., University of Florida, Gainesville, Florida
90-94 Assistant Professor, Materials Sci. and Engr., University of Florida, Gainesville, Florida
89-90 Research Assistant Professor, Materials Sci. and Engr., North Carolina State University, Raleigh, North Carolina

**Administrative Positions**

96-pre **Group Leader,** Chemical Mechanical Planarization (CMP), ERC Univ. of Florida
94-01 **Group Leader,** Engineered Particulates, ERC, University of Florida
94-01 **Associate Director,** Engineering Research Center (ERC) for Particle Science & Technology

**Awards/Honors**

2003 ***Visting Endowed Chair Professor,*** University of Texas (Austin)
2001 ***Fellow: ASM*** (American Society of Materials)
2000 ***Visiting Professor, EPFL,*** Lausanne, Switzerland
2000 ***Distinguished Visiting Scientist,*** NIMC, Tsukuba, Japan
2000 ***University of Florida Research Foundation Award***
1999 ***Distinguished Visiting Professor,*** National University of Singapore, Singapore
1995 ***Hardy Gold Medal*** from TMS/AIME for Outstanding Contributions in Materials Science
1994 ***NSF Young Investigator Award***
94-97 ***Visiting Fellow,*** Center for Ultrafast Optical Science (CUOS), University of Michigan
1992 ***Martin Marietta Innovative Research Aawrd***
1991 ***IBM Faculty Development*** Award
1989 ***MRS Best Graduate Student*** Award
1985 ***Alumni Gold Medal*** for Best Overall Graduating Senior from the University
1985 ***Laha Silver Medal*** for Best Graduate from College of Engineering

## Management and Leadership

**Research leadership:** Unique and diverse research background with demonstrated excellence in several areas spanning from electronic materials, ceramics, metals, polymers to pharmaceutics. Helped in establishing the $66 million ERC Center for Particle Science and Technology at the University of Florida. Developed new cross disciplinary multidisciplinary programs in the university including nano-particle science and technology, chemical mechanical polishing, diamond thin films, angstrom scale characterization, particle coatings, oxide thin films, controlled drug delivery systems. Directed multidisciplinary research groups in the area of chemical mechanical polishing (CMP) and particle coatings; developing efforts in the area nano-bio technology.

**Students & Educational:** Graduated 21 Ph.Ds students in the last 6 years. 6 more Ph.D students expected by end of 2003. Averaging over 3 Ph.D/ year ( top 1% in College of Engineering and ten times the COE average). Managing a group of over 15 –20 graduate students and post doctoral researchers for the last 10 ten years. Graduate students have obtained jobs at leading academic institutions (University of Virginia, etc) and industrial institutions (Intel , Motorola, Samsung, etc.). Actively worked with minority student including recruitment and research training.

**Infrastructure Development:** Established the Characterization, Research Instrumentation and Test-Bed Facility (CRIT) facility for Particle Science and Technology, considered the best facility of its kind in the country. Also obtained NSF and matching funding ($ 3 M) to acquire new state of the art microscopes (STEM-Z and FESEM) and X-ray Diffraction capabilities, which makes MAIC (Major Analytical and Instrumentation Center), one of the premier facilities of its type in the country. Set-up state of art CMP facility, laser and lamp processing lab, plasma CVD, electrical, magnetic and optical characterization facility as a part of group research efforts.

**Management Leadership:** Helped develop the strategic, research and administration plan for the ERC Center. Duties include, developing budgets, and managing staff members associated with the CRIT facility. Developing research plans for multidisciplinary teams on CMP, Engineered particulates and Nanoparticle Science and Technology.

**International Conferences:** Organized 20 international conferences (ECS, MRS, European MRS, TMS, ASM, Engineering Foundation, IUMRS (Japan), Electrochemical Society) in the area of innovative processing of materials, including nanotechnology, chemical mechanical polishing of semiconductors, laser and ion beam processing of materials, rapid thermal processing.

**Industrial Interactions:** Extensive interactions and joint project development with industrial partners such as Dupont, Motorola, Dow Chemical, Lucent, Applied Materials, Motorola, 3M, Intel, IBM, Ashland Chemical, Advanced Micro Devices, Westinghouse (Northtrop Grumman), Seagate, etc.

**Short Courses:** Taught 8 short courses in the last 5 years in the area of thin films, CMP, particle coatings and nanoparticle technology, laser processing of materials at international conferences and at University of Florida.

**Collaborations:** Established a extensive and educational collaboration network leading to joint publications with more than 20 faculty members in the department, college of Engineering and the University. Developed a extensive collaborative research and educational network with the following institutions: University of Michigan, North Carolina State University, NC A&T State University, Southern University, EPFL (Lausanne), NUS (Singapore), NIMC (Japan), Keio University (Japan), Hiedelberg (Germany), Darmstadt (Germany), Oak Ridge National Labs, Sandia National Labs., Unicamp (Sao Paulo), CNRS Strasbourgh (France), IIT Kanpur ( India)

**Guest Editorships:** Guest editor of the October MRS Bulletin 2002 Issue on Chemical Mechanical Polishing (CMP); also guest editor of 5 other journal issues in Materials Science and Engineering B, and Journal of Electronic Materials.

**Technology Licensing and Spin off:** Worked with the office of licensing and technology (OTL at UF) to develop and license several technologies including cleaning of semiconductors, sustained pulmonary based drug delivery systems, slurries for chemical mechanical polishing of copper/ shallow trench isolation(STI);. Spun-off two companies including Nanotherapeutics Inc ( sustained drug delivery systems) and Sinmat Inc ( CMP slurries).

**Research, Educational and Outreach Accomplishments: Productivity and Quality**

**Extensive Multidisciplinary Research Background:** Research activities in the last decade spanning all broad areas of materials science including electronic materials, ceramics, metals, polymers, and bio-materials. Specific areas include silicon based electronics, wide band gap semiconductors, nano-technology, sustained drug delivery, particle coatings and thin films, nano-patterning and lithography, etc.

**Publications**: Over 360 refereed publications including over principal author 200 journal papers; Archival publications in Science, Physical Review B, and Applied Phys. Lett. Over 50 papers in Applied Physics Letters (the highest cited journal in electronic materials). Published more than 10 journal articles in JECS/ESST in the last 5 years. Group averaging 25 journal publications/year in the last 5 years. Publication rate among top 1 % of all MSE and engineering researchers.

**Research Citations;**. Total citations over 2500. Average number of citations/yr >200 in the last 10 years. 5 publications with over 100 citations each. Citations of research papers within the top 1% of all materials science and engineering researchers across the globe and at the University of Florida.

**Books and Book Chapters:** Edited 7 books in various areas of materials processing, written 11 book chapters and review articles and appointed guest editor for 5 journals issues. Presently writing 2 textbooks in the area of CMP (30% complete) and materials characterization techniques (20% complete).

**Patents**: Total of 15 awarded or applied with the US Patent office. Over 50 patent disclosures with the University. [Represent the highest numbers in the college of Engineering and the University and nearly 10 times the COE average]. 5 patent filed for world-wide rights.

**Invited and Contributed Talks:** Presented over 130 invited talks and guest lectures. Research group has presented over 350 papers in the last 10 years at international conferences.

**Softwares**: Written 3 user friendly softwares, including SLIM (Simulation of Laser Interactions with Materials) which is the most widely used software in the area of laser-solid interactions. Has been used by more than 50 institutions across the globe.

**Research Funding**: Attracted over US $2 million/yr in 00-01 and over $11 million in the last 10 years. One of the key persons for the establishment of the $66 million ERC Center for Particle Science and Technology. Also attracted substantial funding from industry (IBM, Motorola, Lockheed Martin, Sun, Ashland Chemicals, etc.). Industrial funding represents 25 % of the total award in the last 5 years.

**Awards/Honors:** Awarded several internationally recognized honors and awards including the Hardy Gold Medal from TMS/AIME for outstanding research contributions, ASM Fellow Award, NSF Young Investigator Award (NYI), University of Florida research foundation award. Research work featured in CNN, NY Times, Wall Street Journal and London Telegraph. Became one of the youngest full professors at the University of Florida at age 33.

**Distinguished Appointments**: Distinguished Visiting Professor at National University of Singapore, Distinguished Visiting scientist at NIMC (Japan), Visiting Professor at EPFL (Lausanne).

**Educational Grants**: Obtained educational grants (PIONEER) from NSF to train minority and graduate students. Developed IGERT proposal. Worked with minority institutions including NCA&T University and Southern University and University of Puerto-Rico.

**Committee and Society Memberships**: The Electrochemical Society (ECS), Materials Research Society (MRS), ASM (American Society for Materials), The Materials Society (TMS), American Vacuum Society (AVS), American Association for Advancement of Science (AAAS). Member of NSF and DOE panels, Reviewer for journals including Science, Nature, Applied Physics Letters, J. Electrochemical Society., etc

APPENDIX 2

3rd EDITION

# QUANTITATIVE ANALYSIS

**R. A. Day, Jr.**
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**A. L. Underwood**
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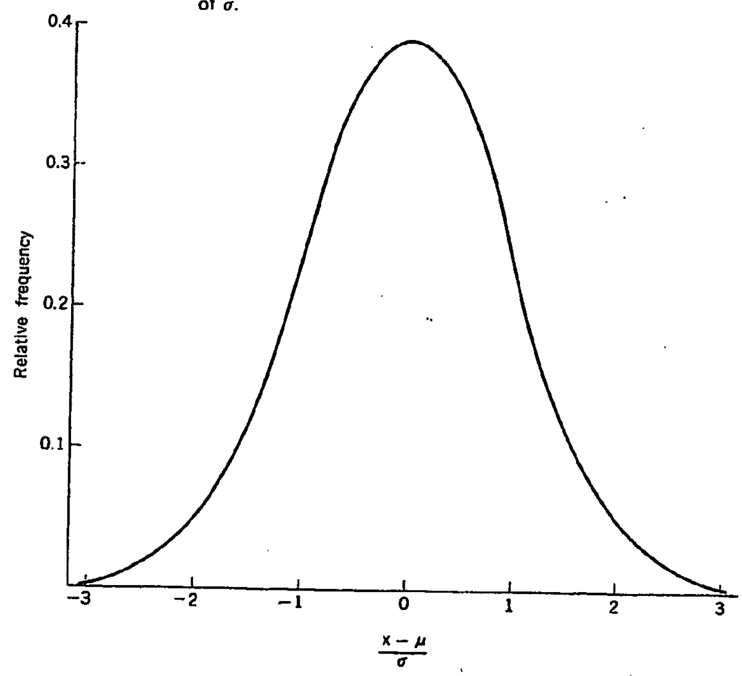
PRENTICE-HALL OF JAPAN, INC., *Tokyo*

### The Normal Error Curve

The limiting case approached by the frequency polygon as more and more replicate measurements are performed is the *normal* or *Gaussian* distribution curve, shown in Fig. 3.2. This curve is the locus of a mathematical function which is well-known, and it is more easily handled than the less ideal and more irregular curves that are often obtained with a smaller number of observations. Data are often treated as though they were normally distributed in order to simplify their analysis, and we may look upon the normal error curve as a model which is approximated more or less closely by real data. It is supposed that there exists a "universe" of data made up of an infinite number of individual measurements, and it is actually this "infinite population" to which the normal error function pertains. A finite number of replicate measurements is considered by statisticians to be a sample drawn in a random fashion from a hypothetical infinite population; thus the sample is at least hopefully a representative one, and fluctuations in its individual values may be considered to be normally distributed, so that the terminology and techniques associated with the normal error function may be employed in their analysis.

**FIGURE 3.2** Normal distribution curve; relative frequencies of deviations from the mean for a normally-distributed infinite population; deviations $(x - \mu)$ are in units of $\sigma$.



The equation of the normal error curve may be written for our purposes as follows:

$$y = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2}$$

Here $y$ represents the relative frequency with which random sampling of the infinite population will bring to hand a particular value $x$. The quantities $\mu$ and $\sigma$, called the population parameters, specify the distribution. $\mu$ is the *mean* of the infinite population, and since we are not here concerned with determinate errors, we may consider that $\mu$ gives the correct magnitude of the measured quantity. It is clearly impractical to determine $\mu$ by actually averaging an infinite number of measured values, but we shall see below that a statement can be made from a finite series of measurements regarding the probability that $\mu$ lies within a certain interval. To the extent of our confidence in having eliminated determinate errors, such a statement approaches an assessment of the true value of the measured quantity. $\sigma$, which is called the *standard deviation,* is the distance from the mean to either of the two inflection points of the distribution curve, and may be thought of as a measure of the spread or scatter of the values making up the population; $\sigma$ thus relates to precision. $\pi$ has its usual significance and $e$ is the base of the natural logarithm system. The term $(x - \mu)$ represents simply the extent to which an individual value $x$ deviates from the mean.

The distribution function may be normalized by setting the area under the curve equal to unity, representing a total probability of one for the whole population. Since the curve approaches the abscissa asymptotically on either side of the mean, there is a small but finite probability of encountering enormous deviations from the mean. A person who happened to encounter one of these in performing a series of laboratory observations would be unfortunate indeed; some of us who have faith in never obtaining such a "wild" result in our own work are inclined to the view that the normal distribution as a model for real data breaks down, and that only the central region of the distribution curve is pertinent when applied to scientific measurements by competent workers. The area under the curve between any two values of $(x - \mu)$ gives the fraction of the total population having magnitudes between these two values. It may be shown that about two-thirds (actually 68.26%) of all the values in an infinite population fall within the limits $\mu \pm \sigma$, while $\mu \pm 2\sigma$ includes about 95% and $\mu \pm 3\sigma$ practically all (99.74%) of the values. Happily, then, small errors are more probable than large ones. Since the normal curve is symmetrical, high and low results are equally probable once determinate errors have been dismissed.

When a worker goes into the laboratory and measures something, we suppose that his result is one of an infinite population of such values that he might obtain in an eternity of such activity; then the chances are roughly 2 to 1 that his measured values will be no further than $\sigma$ from the mean of the infinite population, and about 20 to 1 that his result will lie in the range

$\mu \pm 2\sigma$. In practice, of course, we can never find $\sigma$ for an infinite population, but the standard deviation of a finite number of observations may be taken as an estimate of $\sigma$. Thus we may predict something about the likelihood of occurrence of an error of a certain magnitude in the work of a particular individual once he has performed enough measurements to permit estimation of the characteristics of his particular infinite population.

## STATISTICAL TREATMENT OF FINITE SAMPLES

Although there is no doubt as to its mathematical meaning, the normal distribution of an infinite population is a fiction so far as real laboratory work is concerned. We must now turn our attention to techniques for handling scientific data as we obtain them in practice.

### Measures of Central Tendency and Variability

The *central tendency* of a group of results is simply that value about which the individual results tend to "cluster." For an infinite population, it is $\mu$, the mean of such a sample. The *mean* of a finite number of measurements, $x_1, x_2, x_3, \ldots, x_n$, is often designated $\bar{x}$ to distinguish it from $\mu$. Of course $\bar{x}$ approaches $\mu$ as a limit when $n$, the number of measured values, approaches infinity. Calculation of the mean involves simply averaging the individual results:

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{n} = \frac{\sum_{i=1}^{i=n} x_i}{n}$$

The mean is generally the most useful measure of central tendency. It may be shown that the mean of $n$ results is $\sqrt{n}$ times as reliable as any one of the individual results. Thus there is a diminishing return from accumulating more and more replicate measurements: The mean of four results is twice as reliable as one result in measuring central tendency; the mean of nine results is three times as reliable; the mean of twenty-five results, five times as reliable, etc. Thus, generally speaking, it is inefficient for a careful worker who gets good precision to repeat a measurement more than a few times. Of course the need for increased reliability, and the price to be paid for it, must be decided on the basis of the importance of the results and the use to which they are to be put.

The *median* of an odd number of results is simply the middle value when the results are listed in order; for an even number of results, the median is the average of the two middle ones. In a truly symmetrical distribution, the mean and the median are identical. Generally speaking, the median is a less efficient measure of central tendency than is the mean, but in certain instances it may be useful, particularly in dealing with very small samples.

Since two parameters, $\mu$ and $\sigma$, are required to specify a frequency distribution, it is clear that two populations may have the same central tendency

EVIDENCE APPENDIX

5. Section 132 Declaration of Dr. Kambe

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

| | | |
|---|---|---|
| Applicant | : Kumar et al. | |
| Applic No. | : 09/136,483 | |
| Filed | : August 19, 1998 | Group Art Unit: 1755 |
| For | : ALUMINUM OXIDE PARTICLES | Examiner: M. Marcheschi |
| Docket No. | : N19.12-0016 | |

## DECLARATION UNDER 37 C.F.R. §1.132

BOX AF
Assistant Commissioner for Patents
Washington, D.C. 20231

I HEREBY CERTIFY THAT THIS PAPER IS BEING SENT BY U.S. MAIL, FIRST CLASS, TO THE ASSISTANT COMMISSIONER FOR PATENTS, WASHINGTON, D.C. 20231, THIS 01 DAY OF May, 2000.
Peter S. Dardi
PATENT ATTORNEY

I, Nobuyuki Kambe, hereby declare as follows:

1. I am presently Vice President, Market Development at NanoGram Corporation.

2. I am a founder of NanoGram Corporation, and I have been a Vice President at NanoGram since it was founded in 1996. I have a Bachelor of Science degree and a Master of Science degree in Instrumentation Engineering from Keio University and a Ph.D. in Electrical Engineering from Massachusetts Institute of Technology in 1982.

3. Prior to my employment at NanoGram, I was Senior Managing Director with the International Center for Materials Research (ICMR), a consortium of prominent Japanese companies working jointly on the development of advanced materials. My duties at ICMR included instituting a research and development program in functional polymers and a research and a program in nanopaticles, which was the predecessor of NanoGram. Prior to working with ICMR, I held several positions with Nippon Telephone and Telegraph including Senior Research Scientist and Senior Manager.

4. I have considerable experience in advanced materials research and in particular on nanoparticles and nanomaterials. During my employment with NanoGram, I have worked closely with materials development at NanoGram, and I have also worked extensively with outside companies, consultants and academic researchers toward the development of particular markets and new areas for research related to nanoparticles.

5. I am very familiar with various approaches for producing nanoscale particles, characterization of these particles and the public availability of nanoscale particles with various properties. A successful founder of a technology driven company working in the area of nanoparticles is required to have such knowledge.

6. I am an inventor on the above referenced patent application.

7. I have read all of the references cited by the patent Examiner in the Office Action mailed on February 29, 2000. None of the particle synthesis approaches described in these references is capable of producing nanoparticles having the narrow particle size distribution of the claims pending in the present patent application. Furthermore, I am aware of no approaches that are available to separate nanoscale particles having an average particle size less than about 500 nm to produce a collection of particles with the claimed narrow particle size distribution. In addition, since the approaches described in the cited patents are not capable of producing nanoparticles with narrow particle size distributions, a person of ordinary skill in the art would not have thought, as of our filing date, that the claimed collections of particle would be obvious over the disclosure provided in these references.

8. I am aware of no methods other than the process described in our above noted patent application for producing aluminum oxide nanoparticles having an average particle size less than about 500 nm with the narrow particle size distributions specified in our

pending claims.

9. I declare that all statements made herein that are of my own knowledge are true and that all statements that are made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: May 1, 2000

By: Nobuyuki Kambe
Nobuyuki Kambe, Ph.D.

# NOBUYUKI KAMBE

840 Hobart Avenue
Menlo Park, CA 94025 USA
Tel. 1-650-322-6832
E-mail kambe@nanogram.com

## EDUCATION

1976 - 1982 Massachusetts Institute of Technology Cambridge, MA
*Doctor of Philosophy in Electrical Engineering*

- Dissertation in graphite intercalation materials and their structural behavior
- Visiting researcher at National Magnet Laboratory

1974 - 1976 Keio University Tokyo, Japan
*Master of Science, Instrumentation Engineering*

- Observation of novel phase transition in ultra-thin Au film over C film

1970 - 1974 Keio University Tokyo, Japan
*Bachelor of Science, Instrumentation Engineering*

- Percolation model over the surface of insulators

## PROFESSIONAL EXPERIENCE

1996 - Present NanoGram Corporation Fremont, CA
*Vice President, Market Development*

- Identification, development and planning of new business opportunities for NanoGram particles

1994 - 1996 International Center for Materials Research Kawasaki, Japan
*Senior Managing Director*

- Creation of functional polymer R&D
- Creation of nanoparticle R&D at Lexington, KY as precursor of NanoGram

1981 - 1994 Nippon Telegraph & Telephone (NTT) Tokyo, Japan
*1991 – 1994 Senior Manager at Corporate HQ*

- Strategic corporate planning of new businesses for all NTT technologies
- Completion of technology management course at Japan Productivity Ctr

*1989 – 1991 Senior Research Scientist and Supervisor at Basic Res. Lab.*

- Nonlinear optical materials: synthesis, MBE (molecular beam epitaxy) machine build-up, nonlinear optics measurements
- NTT Basic Res. Lab. Director Award

*1984 – 1989 Stuff Research Scientist*

- Semiconductor superlattice laser devices: GaAs & GaSb-type, device fabrication process development
- Layered semiconductors: GaSe & InSe-type, synthesis, MBE, electron diffraction and spectroscopy, TEM
- Total renovation of high-power x-ray lab: planning and completion of 4 rotor-flex machine facility

*1982 – 1989 Research Scientist*

- Photosensitive materials: synthesis, optical characterization, nonlinear optical measurements

## PATENTS AND PUBLICATIONS

Research interests include electronic and optical properties of low dimensional materials, graphite intercalation compounds, MBE-grown semiconductor thin films and new functional polymers and nanoparticle ceramics.

Ten (10) patents in nanomaterials.

Author of twenty publications and three books.

## LANGUAGES

Japanese (mother tongue)

English (fluent)

## REFERENCES

- Prof. Millie Dresselhaus, Institute Professor at MIT [617-253-6864]
- Mr. William Hecht, CEO at MIT Alumni Association [617-253-8204]
- Dr. Noriyoshi Osumi, VP at NTT America [650-903-0660]
- Dr. Rikuo Takano, Executive Director at Mitsubishi Materials [011-81-422-72-2435]
- Dr. Tatsuo Izawa, Executive Director at NTT [011-81-462-40-5000]
- Dr. Tomoaki Yamada, Fellow at NTT Basic Res. Lab. [011-81-462-40-3350]

EVIDENCE APPENDIX

6. Section 132 Declaration of Dr. Li

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of: Attorney Docket No.: 2950.25US01

Kumar et al. Confirmation No.: 1810

Application No.: 09/136,483 Examiner: Michael A. Marcheschi

Filed: August 19, 1998 Group Art Unit: 1755

For: ALUMINUM OXIDE PARTICLES

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DECLARATION UNDER 37 C.F.R. § 1.132

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Weidong Li, Ph.D., hereby declare as follows:

1. I am presently employed as a Senior Process Engineer at NanoGram Corporation and have worked at NanoGram since 2005.

2. I have a Ph.D. from University of Delaware in Material Science and have further experience as a Postdoctoral Research Scientist at the Center for Composite Materials, in Newark Delaware.

3. I have also previously worked in the area of nanotechnology while obtaining a Masters Degree at the Institute of Metal Research, Chinese Academy of Sciences, Shenyang, China. I have been coauthor on 11 refereed journal articles and two book chapters. A copy of my resume is attached.

4. I have reviewed pending U.S. Patent application serial number 09//136,483 ('483 application). I am not an inventor on this patent application, and I did not participate in any of the work associated with this patent application.

5. I have conducted a literature search related to submicron scale aluminum oxide. As a result of this search, I found two relevant articles before 1999. I understand that these articles will be submitted to the patent office for consideration in this application. It is my conclusion that neither of these references disclose or suggest the materials presently claimed in the '483 application. Specifically, the Borsella article teaches a laser pyrolysis approach with precursors that result in amorphous particles and a carbon coating. These particles required heating at high temperatures to obtain crystalline $Al_2O_3$. The particles had a broad particle size distribution as shown in Fig. 3, so that these particles clearly are distinct from the claimed particles of the '483 application. The Kumar et al. article describes an arc plasma synthesis approach. As noted in the abstract, their particles are a core of metallic aluminum surrounded by a shell of $Al_2O_3$. As can be seem in Figs. 2(a) and 2(c), the particle size distribution is considerable broader than Applicants' claimed distributions. The micrograph shown in Fig. 2(a) strongly suggests larger particles that are precluded from this particular view.

6. I discussed the availability of Nanoparticles of aluminum oxide with Professor Pratsinis of the ETH/Swiss Federal Institute of Technology, Zurich, Switzerland. Professor Pratsinis is a well known expert on the vapor and liquid synthesis of nanoparticles. Professor Pratsinis pointed me to potential sources to explore for these materials.

7. I researched further the availability of commercial aluminum oxide powders. I found that Degussa started selling nanoscale aluminum oxide this year. Upon further research, I found that Aldrich Chemical sold nanoscale aluminum oxide. I could not determine what year these materials were first sold. However, I obtained a sample of these materials. Two scanning electron micrographs of these materials are shown. Some of the clearer particles are labeled with

respect to size. However, as seen throughout the micrograph, there are a large number of smaller particles, and at least some of the larger particles seem to be fused agglomerates of small crystallites indicating that there is a large degree of fusing of the particles. Even the most optimistic evaluation of these particles indicates that the distributions are very significantly broader than the distributions claimed in the '483 application. Therefore, even particles obtainable more than seven years later than the filing date of the '483 patent cannot meet the properties of the materials claimed in the '483 patent.

8. I concluded from all of my research that the materials claimed in the '483 patent were not publicly available from any known source at the filing date of the '483 patent.

9. I declare that all statements made herein that are of my own knowledge are true and that all statements that are made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Weidong Li, Ph.D.

CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that this paper is being transmitted by facsimile to the U.S. Patent and Trademark Office, Fax No. 571-273-8300 on the date shown below thereby constituting filing of same.

December 21, 2005 — Peter S. Dardi

Date — Peter S. Dardi

# WEIDONG LI (Ph.D.)

**CONTACT INFORMATION (1)**
1768 Swanston Way
San Jose, CA 95132
302-897-5578 (mobile)
wdli@nanogram.com

## SUMMARY OF QUALIFICATION:

Have more than twelve-year research experience in the field of synthesis, characterization, and application of nanomaterials and thin films.
Expertise in:

- Synthesis techniques: laser pyrolysis (**LP**), chemical vapor deposition (**CVD**), physical vapor deposition (**PVD**), sol-gel, electrospinning, and rapid solidification (**RSD**).
- Characterization: **XPS**, **XRD**, **TEM/SEM/EDS**, **AFM**, **DLS**, **FTIR**, **UV-VIS**, **DSC**, and **HPLC**.
- Materials design: Structure-property relationships for a wide range of materials such as electronic, optical, magnetic, and catalytic materials.
- Surface science, nanoscience, vacuum science, thin films, solid state physics, polymer physics, physical chemistry, photochemistry, photocatalysis, phosphors, magnetism, device principles, optoelectronics, and electronic materials processing, etc.

## EXPERIENCE:

**Senior Process Engineer (2005-Present)**
NANOGRAM CORPORATION, San Jose, CA, 95134

1. Process engineer for advanced nanomaterials synthesis and characterization: Process development and optimization of nanoscale materials synthesis using the NanoGram's proprietary process, development and optimization of technology to treat these nanoscale materials to enable their use in product applications, scheduling development activities, managing technicians who operate advanced materials synthesis equipment and also communicating weekly progress internally and to the customer in meetings.

**Postdoctoral Fellow** (2004 – 2005)
CENTER FOR COMPOSITE MATERIALS, Newark, DE, 19716

1. Electrospinning of nanofibers and application of nanofibers in composite materials.
2. Study of surface sizing of glass fibers by nanoparticles with silane for impact resistance enhancement of composites
3. Surface characterization of polymer fiber reinforced composite materials by XPS, SEM, XRD, TEM, and FTIR

**Research Assistant** (1998-2003)
UNIVERSITY OF DELAWARE, Newark, DE

1. Designed and improved procedure for the synthesis of high quality $TiO_2$ nanoparticles and thin films in MOCVD system.
2. Achieved visible light absorption for wide band gap $TiO_2$.
3. Developed a new method for DC magnetron sputtering of high C concentration of metastable $Ge_{1-x}C_x$ epitaxial thin films on Si(100) substrates.
4. Trained students for use of materials synthesis and characterization techniques.

**Research Assistant** (1995-1998)
CHINESE ACADEMY OF SCIENCE, Shenyang, China

1. Designed and synthesized two-phase nanocomposite $\alpha$-Fe/$Nd_2Fe_{14}B$ magnetic materials by rapid solidification with annealing procedure.
2. Improved magnetic property of nanosize Nd-Fe-B by addition of metal ions.

**Graduation Practice** (1994.8-1994.11)
Qishuyan Locomotive & Rolling Stock Works, Changzhou, China
1. Conducted structure/composition analysis for train engine parts by EDS and XRD.
2. Performed SEM analysis for mechanical parts failure.

**Summer Intern** (1993.6-1993.7)
Nanjing 2nd Chemical Mechanics, Nanjing, China
1. Conducted heat treatment and thermal analysis for metal phase transformation.
2. Materials surface analysis and preparation for welding.

## EDUCATION:

**Ph.D. in Materials Science 2004.2**
Dept. of Materials Science and Engineering, University of Delaware, Newark, DE
Dissertation:"Metalorganic chemical vapor deposition and characterization of $TiO_2$ nanoparticles", Advisor: Prof. Ismat Shah
GPA: 3.8/4.0

**M.MSE. 2001.5**
Dept. of Materials Science and Engineering, University of Delaware, Newark, DE
Thesis: "Growth and characterization of Ge1-xCx expitaxial layers on Si(100) substrates", Advisor: Prof. Ismat Shah
GPA: 3.8/4.0

**M.E. 1998.6**
Institute of Metal Research, Chinese Academy of Sciences, Shenyang, China
Thesis: "The effect of addition element and magnetic annealing on magnetic properties of melt-spun nano-phase Nd-Fe-B alloy", Advisor: Prof. Mingxiu Quan
GPA: 3.5/4.0

**B.E. 1995.7**
Department of Materials Science and Technology,
Nanjing University of Aeronautics and Astronautics, Nanjing, China
GPA: 3.8/4.0

## HONORS AND AWARDS:

- Member of Sigma Xi the Scientific Research Society, 2005.
- Materials Research Society (MRS) Graduate Research Award, Silver Medal 2003.
- American Vacuum Society (AVS) Graduate Research Award, 2002.
- AVS Russell & Sigurd Varian Fellowship, Finalist 2002.
- AVS Dorothy and Earl S. Hoffman Travel Scholarship, Annually 2000-2003.
- Undergraduate student fellowship, Annually1992-1994.

## PUBLICATIONS:

### I: PAPERS

1 H. Lin, C.P. Huang, **W. Li**, C. Ni, and S.I. Shah, "Size dependency of nanocrystalline $TiO_2$ on its optical property and photocatalytic reactivity examplified by 2-Chlorophenol," *Appl. Catal. B, accepted (2006)*

2 **W. Li**, A. Frenkel, J. Woick, C. Ni, and S.I. Shah, "Dopant location identification in $Nd^{3+}$-doped $TiO_2$ nanoparticles," *Phys. Rev. B 72, 155315 (2005)*

3 **W. Li**, C. Ni, H. Lin, C. P. Huang, and S. I. Shah, "Size dependence of thermal stability of $TiO_2$ nanoparticles," *J. Appl. Phys. 96, 6663 (2004).*

4 A. Burns, H. Greg, **W. Li**, J. Hirvonen, J. D. Demaree, and S. I. Shah, "Neodymium-ion dopant effect on the phase transformation of nanostructured $TiO_2$ synthesized by sol-gel," *Mater. Sci. Eng. B 111, 150 (2004).*

5 **W. Li**, Y. Wang, H. Lin, S.I. Shah, C.P. Huang, D. J. Doren, S. A. Rykov, J.G. Chen, and M.A. Barteau, "Band gap tailoring of $Nd^{3+}$ -doped $TiO_2$ nanoparticles," *Appl. Phys. Lett. 83, 4143 (2003).*

6 **W. Li**, S.I. Shah, C.-P. Huang, O. Jung, and C. Ni, "Metalorganic chemical vapor deposition and characterization of $TiO_2$ nanoparticles," *Mater. Sci. Eng. B 96, 247 (2002).*

7 **W. Li**, S.I. Shah, M. Sung, and C.-P. Huang, "Structure and size distribution of $TiO_2$ nanoparticles on stainless steel mesh," *J. Vac. Sci. Technol. B 20, 2303 (2002).*

8 **W. Li**, S.I. Shah, D. Guerin, J.G. Chen, and H. Hwu, "Growth and characterization of epitaxial $Ge_{1-x}C_x$ thin films on (100) Si," *J. Vac. Sci. Technol. A 19, 2617 (2001).*

9 S.I. Shah, **W. Li**, C.-P. Huang, O.Jung, and C. Ni, "Study of $Nd^{3+}$, $Pt^{4+}$, $Pd^{2+}$, and $Fe^{3+}$ dopant effect on the photoreactivity of $TiO_2$ nanoparticles," *PNAS, USA 99, 6482 (2002).*

10 W.S. Sun, **W. Li**, and M.X. Quan, "Remanence enhancement and microstructure in a two-phase $Nd_{10}Fe_{83}B_6Al_1$ nanocrystalline alloy," *Internatl J. of Non-Equilibrium Processing 10, 297(1998).*

11 **W.D. Li**, T.M. Zhao, M.X. Quan, and Z.Q. Hu, "Effect of Al content on glass forming ability, microstructures, and magnetic properties of $\alpha$-Fe/$Nd_2Fe_{14}B$," *Functional Materials (Chinese), 29, 232(1998).*

### II. CONFERENCE PROCEEDINGS

1 S. Chiruvolu, **W. Li**, M. Ng, K. Du, C. Horne, B. McGovern, and R. Mosso et al. "Laser pyrolysis – a platform technology to produce functional nanoscale materials for a range of applications," *Nano Sci. Technol. Inst. (NSTI) 2006 (accepted)*

2 A. Burns, **W. Li**, C. Baker, and S.I. Shah, "Sol-gel synthesis and characterization of neodymium doped nanostructured titania thin films," *Proc. Mater. Res. Soc. Sym. 703, 193 (2002).*

### III: BOOK CHAPTERS

1 **W. Li** and S.I. Shah, "Semiconductor Nanoparticles for Photocatalysis" in Encyclopedia of Nanoscience and Nanotechnology, Vol. 9, p. 669-695 (2004). (H. S. Nalwa, Ed., American Scientific Publishers, Stevenson Ranch, CA). **ISBN: 1588830659**

2 S. I. Shah, A. Rumaiz, and **W. Li**, "Nanostructured Catalysts for Environmental Applications" in Nanotechnology and the Environment, (B. Karn, et al. Eds.). American Chemical Society/Oxford University Press, 2005, **ISBN: 0841238774**

### VI. Patent:

"Highly Crystalline Nanoscale Phosphor Particles and Composite Materials Incorporating the particles", to be filed soon. (Attorney Docket No.: 2950.87US02).

### SELECTED TALKS:

CO-PRESENTER "Laser pyrolysis - a platform technology to produce functional nanoscale materials for a range of applications" NSTI Nanotech, Boston, MA, May 2006.
PRESENTER "Band gap tailoring of Nd doped nanoparticles" MRS symposium, Boston, MA, December 2003.

PRESENTER "Size dependence of structural, optical, and photocatalytic properties of $TiO_2$ nanoparticles." 50th AVS International Symposium, Baltimore, MD, November 2003.
PRESENTER "Structural, optical, and photoreactivity of $Nd^{3+}$ doped $TiO_2$ nanoparticles." 49th AVS International Symposium, Denver, CO, November 2002.
PRESENTER "Chemical vapor deposition and characterization of $TiO_2$ nanoparticles" 48th AVS International Symposium, San Francisco, CA, October 2001.
PRESENTER "Dual magnetron sputtering and characterization of GeC thin films on Si (100) substrates." 47th AVS International Symposium, Boston, MA , October 2000.
CO-PRESENTER "Sol-gel synthesis and characterization of $Nd^{3+}$ doped $TiO_2$ nanostructured thin films." MRS symposium, Boston, MA, November 2001.
CO-PRESENTER "MOCVD synthesis of different dopant doped $TiO_2$ nanoparticles for photocatalysis." Arthur M. Sackler Colloquium of National Academy of Sciences, Washington DC, May 2001.

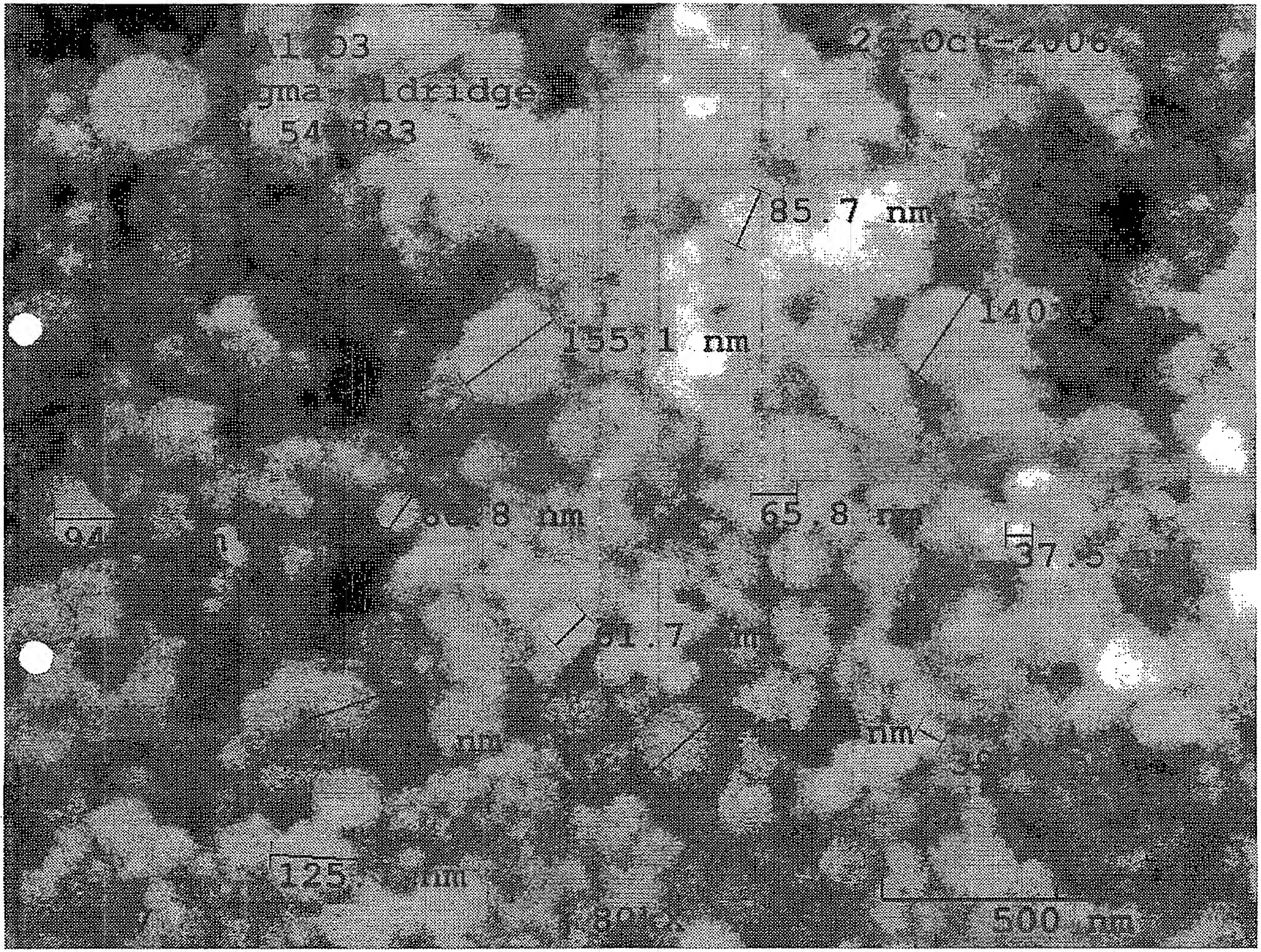
**SERVICE:**

- **Reviewer/Referee**
  Nanotechnology
  Thin Solid Films
  Journal of Environmental Management
  Industrial & Engineering Chemistry Research
  Central European Journal of Chemistry
  Journal of Physical Chemistry
  Journal of Nanoscience and Nanotechnology
  Journal of Solid State Chemistry
- **Memberships**
  Sigma Xi the Scientific Research Society
  American Vacuum Society (AVS)
  Materials Research Society (MRS)

**COMPUTER SKILLS:**

MATLAB, Maple, LabView, AutoCAD, Adobe Photoshop, Macromedia Flash, FrontPage, Dream Weaver, MS Office Tools, C++, Java, Scion Image, XFIT.

**REFERENCES (upon request)**



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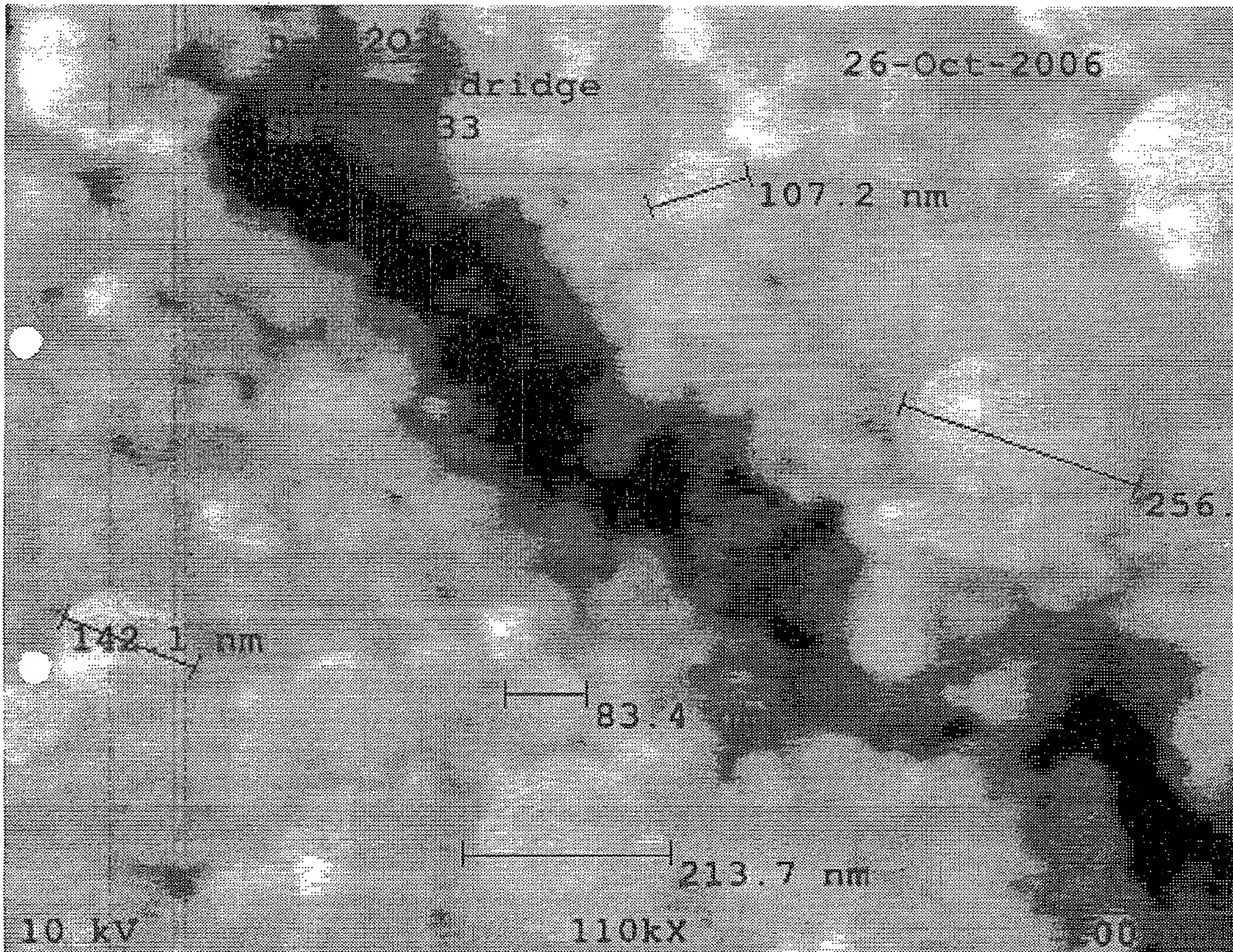
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83.4
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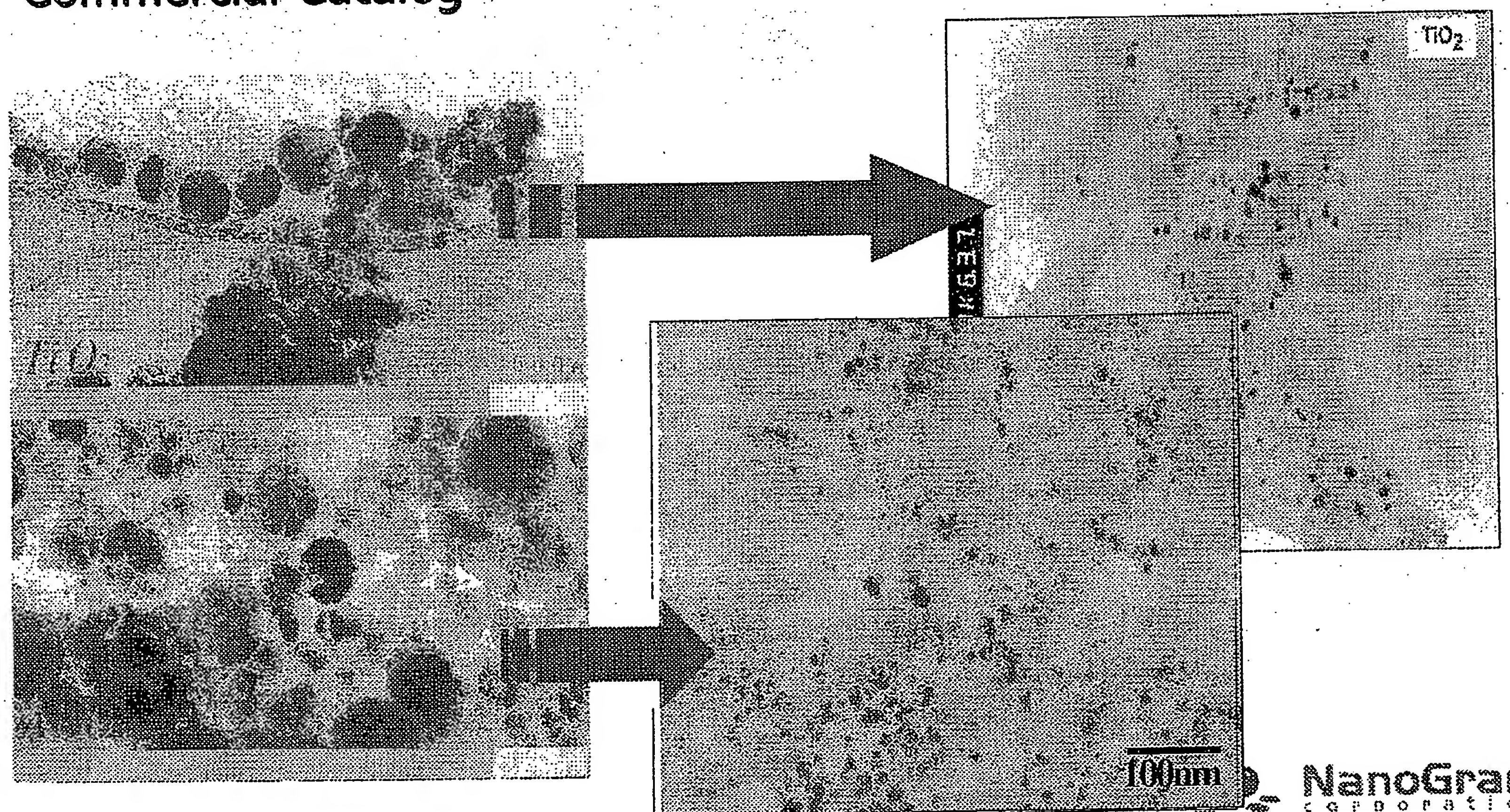
10 kV
110kX

# Sample Comparison vs. Other Synthesis Technologies

Commercial Catalog




$Al_2O_3$

NanoGram corporation

EVIDENCE APPENDIX

7. U.S. Patent No. 5,128,081 to Siegel

EVIDENCE APPENDIX

8. Siegel et al. "Structure and Properties of Nanophase TiO2." Journal de Physique.

JOURNAL DE PHYSIQUE
Colloque C5, supplément au n°10, Tome 49, octobre 1988 

# STRUCTURE AND PROPERTIES OF NANOPHASE $TiO_2$

R.W. SIEGEL, H. HAHN[1], S. RAMASAMY[2], L. ZONGQUAN[3], L. TING[4] and R. GRONSKY*

*Materials Science Division, Argonne National Laboratory, Argonne, IL 60439, U.S.A.*
**National Center for Electron Microscopy, Lawrence Berkeley Laboratory, University of California, Berkeley, California, U.S.A.*

Résumé - Echantillons de $TiO_2$ (rutile) nanophasé de grains ultrafins ont été synthétisés par la méthode de condensation dans un gaz, suivie ensuite par compaction en-situ, et étudiés par microscopie électronique en transmission, par microdureté de Vickers, et par spectroscopie d'annihilation positronique en fonction de température de frittage. La densité des échantillons augmente rapidement au-dessus de 500°C avec seulement une légère croissance de grains. La dureté obtenue par cette méthode, effectuée aux températures 400-600°C plus basses que la température de frittage conventionnel et sans avoir besoin des additives de frittage, est comparable ou supérieure à celle des échantillons de gros grains.

Abstract - Ultrafine-grained, nanophase samples of $TiO_2$ (rutile) were synthesized by the gas-condensation method and subsequent in-situ compaction, and then studied by transmission electron microscopy, Vickers hardness measurements, and positron annihilation spectroscopy as a function of sintering temperature. The nanophase compacts densified rapidly above 500°C, with only a small increase in grain size. The hardness values obtained by this method are comparable to or greater than coarser-grained compacts, but at temperatures 400 to 600°C lower than conventional sintering temperatures and without the need for sintering aids.

## 1. INTRODUCTION

The gas-condensation method [1-3] for the production of small particles in the size range of 1 to 50 nm has recently enabled the synthesis of a new class of ultrafine-grained materials by the in-situ compaction and sintering of these particles [4]. The resulting nanophase materials, which may contain crystalline, quasicrystalline, or amorphous phases, can be metals, ceramics, or composites with rather different and improved properties than normal coarse-grained polycrystalline materials. The work so far done on these new materials and their potential for the future have been recently reviewed [5,6]. Some advantages of nanophase ceramics should be: (i) Their small particle size during synthesis should allow for increased sinterability at lower temperatures and smaller residual pore sizes owing to a combination of high driving forces and short diffusion distances, avoiding the need for sintering aids. (ii) The exceptional physical and chemical control available in the gas-condensation method lets the particle surfaces be maintained clean allowing subsequent high grain-boundary purity and thus negligible interfacial phase formation. (iii) The large fraction

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of atoms residing in interfaces, almost one-half in the case of a 5 nm grain size, may allow for new atomic arrangements and thus novel and improved ceramic properties. Such properties may include, for example, mechanical properties which might be improved through higher grain-boundary purity and the absence of brittle phases therein or small grain sizes allowing for more efficient deformation mechanisms and more effective crack dissipation.

In order to explore the feasibility of creating nanophase ceramics with such improved properties, ultrafine-grained nanophase $TiO_2$ (rutile) samples were synthesized in the present work by the gas-condensation method and then studied by a variety of techniques as a function of sintering temperature. The desirability of small and uniform particle size for obtaining quality ceramics has been well documented for ceramics in general [7] and for $TiO_2$ specifically [8,9]. Nanophase ceramics, with their high grain-boundary purity and very small and rather uniform particle size, are expected to sinter at lower temperatures than normally available ceramics with larger particle sizes, and to exhibit improved properties [6]. Consequently, for comparison with the nanophase samples, coarser-grained samples were also synthesized from commercial powders and similar measurements were carried out.

## 2. EXPERIMENTAL PROCEDURE

The ultra-high vacuum chamber used for the preparation of nanophase $TiO_2$ by the gas-condensation method has been described elsewhere [6]. Titanium (99.7% pure) was evaporated from a resistance-heated tungsten boat at temperatures between 1550°C and 1650°C into a 0.3-0.7 kPa helium atmosphere over a period of 15 to 30 min. The small Ti particles formed by condensation in the He-gas were deposited on the cold-finger of the production chamber, and subsequently oxidized by the introduction of about 2 kPa of oxygen into the chamber. The particles were then compacted at 1.4 GPa at room temperature, resulting in a $TiO_2$ nanophase compact of 9 mm diameter by about 0.2 mm thick with a mean grain diameter of 12 nm.

For comparison with the nanophase $TiO_2$, samples were also synthesized from commercial $TiO_2$ powder, which was ball-milled using NiO balls to an average grain size of 1.3 µm, with a maximum grain size of 2.5 µm. Three samples were made from this commercial powder. The first was compacted at 1.4 GPa at room temperature without any sintering aid, as a direct comparison with the nanophase sample, while the second was compacted at the same pressure, but using a 5% aqueous solution of polyvinyl alcohol (pva) as a sintering aid. The third sample was compacted at 0.1 GPa with the same pva solution, this method being essentially the conventional one for the preparation of such a ceramic. The densities of the green pellets ranged from 55 to 70% of theoretical density.

Grain-size distributions were determined in the nanophase samples by transmission electron microscopy (TEM), and in the coarser-grained samples by scanning electron microscopy (SEM). Vickers microhardness was measured at room temperature, using a load of 15 g and an indentation time of 25 s, on the as-compacted samples and after sintering successively for one-half hour at temperatures up to 1400°C. Complementary positron annihilation spectroscopy (PAS) lifetime and Doppler-broadening measurements were also made in order to monitor sample porosity as a function of sintering up to 900°C. In addition, high-resolution electron microscopy (HREM) observations of grain and grain-boundary structures were also carried out on selected nanophase samples using the Atomic Resolution Microscope at the National Center for Electron Microscopy, LBL. An operating voltage of 1 MeV was chosen to provide better penetration of some of the thicker particles while retaining resolution at the 0.16 nm level. No attempt was made to orient the individual particles under the electron beam; instead, the samples were scanned for large thin areas and imaged in through-focus series bracketing the minimum contrast [10] condition.

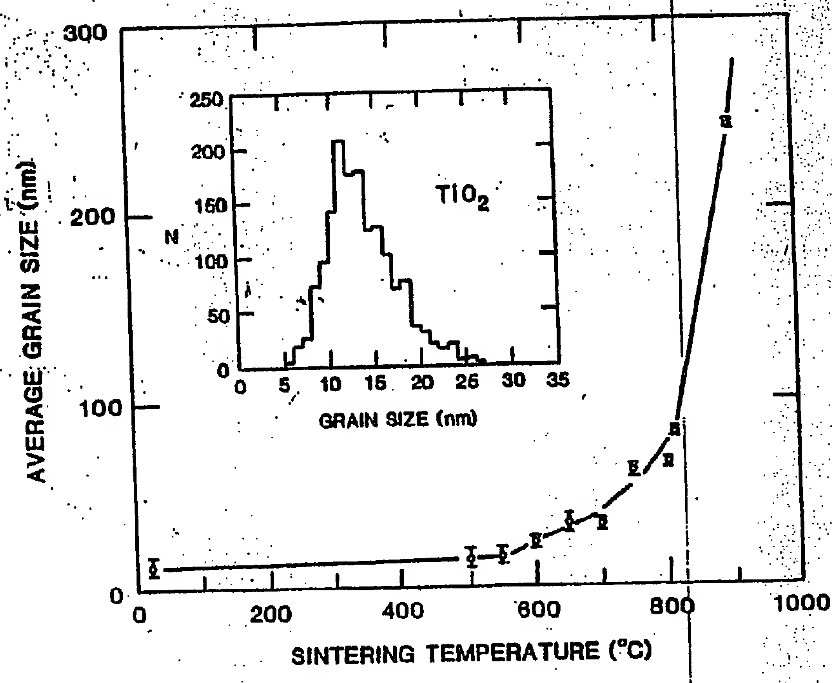


Figure 1. Average grain size of nanophase $TiO_2$ (rutile) as a function of sintering temperature determined by TEM. The sintering anneals were one-half hour in duration at each successive temperature. The grain-size distribution for the as-compacted sample is shown in the inset.

### 3. RESULTS AND DISCUSSION

The results of the grain-size determinations using TEM on the nanophase $TiO_2$ as a function of sintering temperature are presented in Figure 1. It can be seen that the grain-size distribution for the as-compacted sample is rather narrow and typical of the particle-size distribution produced in the gas-condensation method [2]. The distribution appears to remain unchanged by the Ti oxidation and subsequent compaction processes. It can also be readily seen that the average grain size increases very little up to about 550°C, and only rather slowly with sintering temperature up to about 800°C, at which temperature grain growth becomes fairly rapid. A similar grain-size stability against temperature has been found for nanocrystalline iron with an initial average grain size of 6 nm [11].

Figure 2 shows a high-resolution electron micrograph from a rather typical region of the nanophase $TiO_2$ sample sintered for one-half hour at 500°C. The grains here are seen to be essentially equiaxed with relatively planar boundaries. The grain boundaries in the as-compacted sample, on the other hand, appeared to be significantly less planar than this, but detailed atomic structural studies of these nanophase boundaries have not yet been completed. The lattice fringes seen in Figure 2 are those representative of the atomic planes of rutile, as confirmed by both electron and X-ray diffraction patterns on all of these samples.

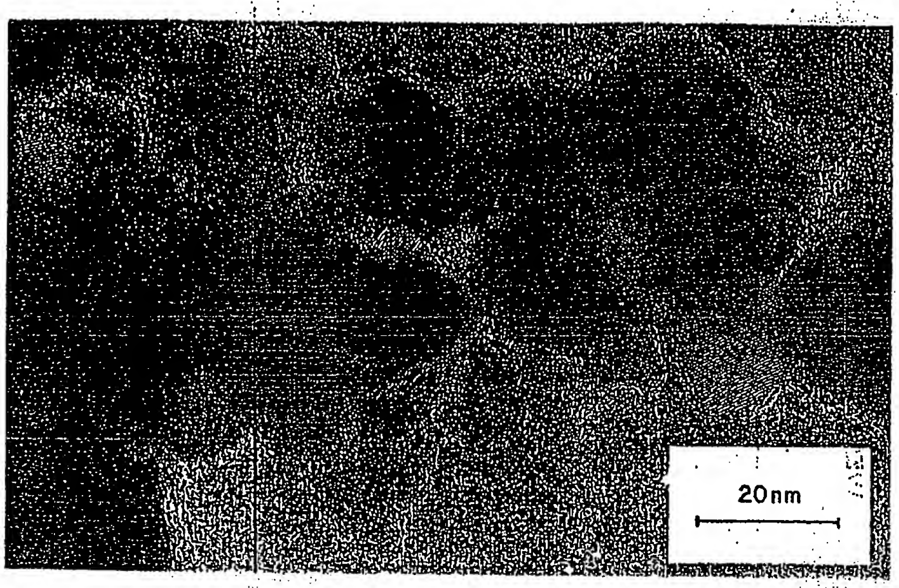


Figure 2. High-resolution transmission electron micrograph of nanophase $TiO_2$ (rutile) after sintering for one-half hour at 500°C. The sample was prepared for TEM observation by fracturing the sintered compact, which gave rise to the open areas seen in the micrograph.

The Vickers microhardness measured at room temperature is shown in Figure 3 as a function of sintering temperature for three different $TiO_2$ (rutile) samples, the nanophase sample with 12 nm initial average grain size compacted at 1.4 GPa, and two samples with 1.3 μm initial average grain size compacted at 1.4 GPa and 0.1 GPa. The latter sample, prepared essentially in accord with standard ceramic processing methods, was the only one of these three which was sintered with the aid of pva. The results for a fourth sample prepared in a similar manner with pva but compacted at 1.4 GPa, are not shown in Figure 3; they are very similar to those for the 1.3 μm, 0.1 GPa sample, but shifted to lower temperatures by about 150°C. It can be readily seen from these microhardness measurements that the nanophase $TiO_2$ sinters at considerably lower (between 400 and 600°C) temperatures than the commercial 1.3 μm powder with the aid of pva, yielding comparable or greater microhardness values. For reference, the Vickers microhardness of a single crystal of $TiO_2$ measured under identical conditions is 1036 ± 66 kgf/mm$^2$. Preliminary fracture toughness studies on these samples, made by measuring the crack lengths emanating from microindentations at higher loads, appear to confirm the similar or better mechanical properties of the nanophase $TiO_2$ in comparison with the coarser-grained material and single-crystal $TiO_2$ (rutile) as well. Without the aid of pva, the commercial powders are seen to sinter rather poorly and exhibit inferior mechanical properties, as expected.

Although it seems apparent from the microhardness measurements that densification of the nanophase sample was taking place upon sintering above 500°C, PAS measurements were also carried out in order to monitor this densification more directly. The results, which will be published elsewhere by the present authors in a more complete account of this study of nanophase $TiO_2$, show in their simple two-state behavior that both the 12 nm, 1.4 GPa nanophase sample and the 1.3 μm, 1.4 GPa commercial-powder sample (see Figure 3) began densifying rapidly above 500°C, but that the nanophase sample did so more rapidly with increasing

temperature than the coarser-grained sample, resulting in a smaller void or pore density at 900°C. As might have been expected, the PAS lifetime measurements, which are also sensitive to varying pore sizes when they are small, clearly indicate smaller pore sizes in the nanophase sample relative to the coarser-grained sample at all the sintering temperatures investigated by PAS.

The results of these first investigations on nanophase $TiO_2$ indicate that these compacts, although already rather well bonded on compaction at room temperature, densify rapidly above 500°C, with only a small increase in grain size. The hardness values obtained by this method are comparable to or greater than those of single-crystal $TiO_2$ or coarser-grained compacts, but at temperatures some 400 to 600°C lower than conventional sintering temperatures and without the need for sintering aids. Much work still needs to be done regarding the characterization of nanophase ceramics and the elucidation of their full potential. However, the results of this first study appear to hold considerable promise for the future of nanophase ceramics.

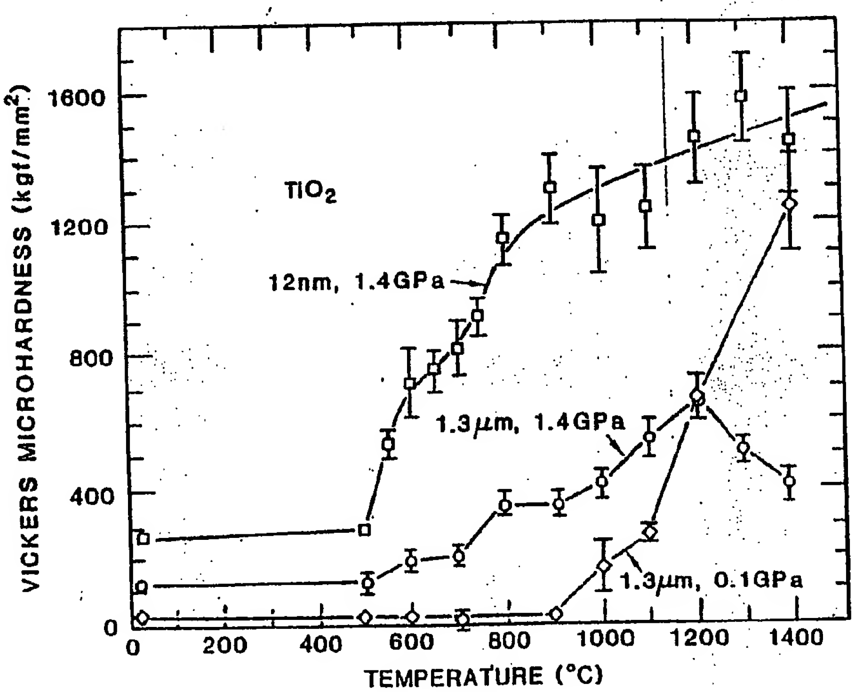


Figure 3. Vickers microhardness in kgf/mm$^2$ of $TiO_2$ (rutile) measured at room temperature as a function of one-half hour sintering at successively increased temperatures. Results for a nanophase sample (squares) with an initial average grain size of 12 nm compacted at 1.4 GPa are compared with those for coarser-grained compacts with 1.3 μm initial average grain size sintered at 0.1 GPa with (diamonds) and at 1.4 GPa without (circles) the aid of polyvinyl alcohol from commercial powder.

ACKNOWLEDGEMENT

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RELATED APPEALS APPENDIX

Decision of the Board of Patent Appeals and Interferences in Appeal 2001-1031, *Ex parte* Kumar.

Decision of the U.S. Court of Appeals for the Federal Circuit in Appeal 04-1074, *In re* Kumar.

The opinion in support of the decision being entered today was <u>not</u> written for publication and is <u>not</u> binding precedent of the Board.

Paper No. 28

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

DOCKETED

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<u>Ex parte</u> SUJEET KUMAR, HARIKLIA DRIS REITZ, XIANGXIN BI
and NOBUYUKI KAMBE

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MAILED

FEB 27 2003

PAT. & T.M. OFFICE
BOARD OF PATENT APPEALS
AND INTERFERENCES

Appeal No. 2001-1031
Application 09/136,483

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ON BRIEF

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Before GARRIS, LIEBERMAN, and POTEATE, <u>Administrative Patent Judges</u>.

POTEATE, <u>Administrative Patent Judge</u>.

<u>DECISION ON APPEAL</u>

This is an appeal under 35 U.S.C. § 134 from the examiner's refusal to allow claims 1-3 and 5-22, which are all of the claims pending in the application.

Request for Reconsideration deadline 3-27-03;
Notice of Appeal to CAFC deadline 4-27-03

Claims 1, 17 and 19 are representative of the subject matter on appeal and are reproduced below:

1. A collection of particles comprising aluminum oxide, the collection of particles having an average diameter of primary particles from about 5 nm to about 500 nm and less than about one in $10^6$ particles have a diameter greater than about three times the average diameter of the collection of particles.

17. A method for producing a collection of aluminum oxide particles having an average diameter from about 5 nm to about 500 nm, the method comprising:
flowing a molecular stream through a reaction chamber, the molecular stream comprising an aluminum precursor, an oxidizing agent, and an infrared absorber; and
pyrolyzing the flowing molecular stream in a reaction chamber, where the pyrolysis is driven by heat absorbed from a continuous wave laser beam.

19. A collection of particles comprising aluminum oxide, the collection of particles having an average diameter from about 5 nm to about 500 nm and a distribution of particle sizes such that at least about 95 percent of the particles have a diameter greater than about 40 percent of the average diameter and less than about 160 percent of the average diameter.

The references relied upon by the examiner are:

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| Shimo | 5,064,517 | Nov. 12, 1991 |
| Rostoker et al. (Rostoker) | 5,389,194 | Feb. 14, 1995 |
| Ueda et al. (Ueda) | 5,697,992 | Dec. 16, 1997 |

GROUNDS OF REJECTION[1]

1. Claims 1-3, 5-16 and 19-22 stand rejected under 35 U.S.C. § 103 as unpatentable over Rostoker alone or in view of Ueda. We affirm.

2. Claims 17 and 18 stand rejected under 35 U.S.C. § 103 as unpatentable over Shimo. We reverse.

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[1] The following grounds of rejection have been withdrawn:

1. The rejection of claims 1-3 and 5-16 under 35 U.S.C. § 112, second paragraph as indefinite;
2. The rejection of claims 1-3, 5-8 and 19-22 as unpatentable under 35 U.S.C. § 103 over any one of Sugoh, Ota, Arai, Moser and Helble;
3. The rejection of claims 1-3, 5-16, and 19-22 as unpatentable under 35 U.S.C. § 103 over Ueda and over Sakatani, Atsugi, Rosenblum, Zipperian, Rostoker '130, and Nevelle, taken alone or in view of Ueda;
4. The rejection of claims 17 and 18 as unpatentable under 35 U.S.C. § 103 over Sugoh, Ota, Arai, Moser, Helble, Sakatani, Ueda, Atsugi, Rosenblum, Zipperian, Rostoker 130, Rostoker 194 and Neville, and further in view of Shimo;
5. The provisional obviousness-type double patenting rejection of claims 1-3, 5-16 and 19-22 as unpatentable over claims 1-3, 5-9 and 11-16 of copending application no. 08/961,735. See Examiner's answer, paper no. 22, mailed November 16, 2000, pages 3-5, paragraph (10), Grounds of Rejection. This application has now issued as U.S. Patent No. 6,290,735 (September 18, 2001).

Appellants indicate that an issue on appeal is "[w]hether the claims are obvious over the claims of copending application 09/433,202?" Appeal brief, paper no. 19, received September 5, 2000. The claims have not, however, been finally rejected over the claims of copending application 09/433,202. See Final rejection, paper no. 14, mailed February 29, 2000, page 13 ("the examiner has not made an ODP rejection over the CIP application (09/433,202).")

## BACKGROUND

The invention relates to collections of submicron aluminum oxide particles. Appeal brief, page 3, second paragraph. The particles are used, for example, for polishing hard materials such as semiconductors, ceramics, glass and metal. Specification, page 1, lines 15-17. The invention is further directed to a process for producing these particles using laser pyrolysis. Appeal brief, page 3, third paragraph.

According to appellants, the claimed collections of particles are extremely uniform in particle size. Appeal brief, page 3, second paragraph. Uniformity refers to the fact that the distribution of particle sizes around the average drops off very quickly and the particle size distribution does not have a tail, i.e., there are no particles above a certain cut off value. Id. Uniformity is important to ensure optimum polishing conditions. See specification, page 4, lines 10-18. In particular, particles which are larger than a certain cut off value tend to scratch the surface being polished, while particles which are significantly smaller than a desired cut off value are less effective in polishing and dilute the polishing composition with essentially useless material. See e.g., Rostoker, column 7, lines 55-61; Appeal brief, page 22, third paragraph.

DISCUSSION

1. Rejection of claims 1-3, 5-16 and 19-22 under 35 U.S.C. § 103 as unpatentable over Rostoker alone or in view of Ueda.[2]

The examiner found that:

> Rostoker et al. teach a polish comprising alumina particles having a size within the claimed range and therefore no distinction is seen to exist because the subject matter as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have selected the overlapping portion of the range disclosed by the reference because overlapping ranges have been held to be a prima facie case of obviousness, *see In re Malagari*, 182 U.S.P.Q. 549.

Examiner's answer, page 4.

Appellants concede that Rostoker discloses aluminum oxide particles having an average particle size which overlaps the claimed average particle size. See appeal brief, page 14, second paragraph. However, appellants maintain that Rostoker does not disclose or suggest the particle size distribution of the claimed

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[2] For purposes of this appeal, appellants separately argue the patentability of three groups of claims: (1) claims 1-3 and 5-16, (2) claims 17 and 18, and (3) claims 19-22. In accordance with 37 CFR § 1.192(c), we shall decide the appeal as to this ground of rejection on the basis of claims 1 and 19. Ueda is relied on by the examiner as disclosing that it is known to use non-aqueous or aqueous mediums in making polishing compositions. See Examiner's answer, page 4, last sentence. Neither claim 1 nor claim 19 includes a limitation relating to the medium in which the claimed particles are dispersed (such limitation is present in claim 9 and the claims which depend therefrom). Accordingly, we need not address the Ueda patent.

collection of particles. Id. In this regard, appellants note that "[t]he particle size distribution is an independent property of the powders. Thus, two collections of powders can have the same average particle size, but a very different particle size distribution." Id. Appellants provide several reasons as to why Rostoker does not disclose or suggest the particle size distribution recited in claims 1 and 19. For the reasons discussed below, we do not find appellants' arguments persuasive.

Appellants argue that the only process disclosed by Rostoker for obtaining nanoparticles of aluminum oxide is a process described in U.S. Patent No. 5,128,081 to Siegel et al. (the Siegel patent). Appeal brief, page 22. According to appellants, the Siegel patent describes the use of a gas phase condensation method which leads to a tail at larger particle sizes such that the resultant particle size distribution is outside of appellants' claimed ranges. Id. As pointed out by the examiner, Rostoker does not state that the only method of making his particles is via the method disclosed in the Siegel patent. Examiner's answer, page 6, second paragraph. Rather, Rostoker merely references the Siegel patent as disclosing one known method for controllably producing ultrafine-grained or nanocrystalline materials. See Rostoker, column 6, lines 24-34.

In making a patentability determination, analysis must begin with the question, "*what* is the invention *claimed*?" since "[c]laim interpretation, . . . will normally control the remainder of the decisional process." Panduit Corp. v. Dennison Mfg. Co., 810 F.2d 1561, 1567-68, 1 USPQ2d 1593, 1597 (Fed. Cir.) cert. denied, 481 U.S. 1052 (1987). Claims 1 and 19 both claim "A collection of particles *comprising* . . . ." Use of the word "comprising" does not preclude the presence of additional components or particles. See In re Baxter, 656 F.2d 679, 686, 210 USPQ 795, 802 (CCPA 1981). Thus, as pointed out by the examiner, the claims, as drafted, do not preclude the presence of a tail. See Examiner's answer, page 7. Further, claims 1 and 19 are not in any way limited to a collection of particles produced by Appellants' laser pyrolysis method. See In re Morris, 127 F.3d 1048, 1054, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997). (In determining the patentability of claims, the PTO gives claim language its "broadest reasonable interpretation" consistent with the specification and claims).

In any event, we are further in agreement with the examiner that Rostoker discloses a collection of particles having both the sizes *and* distribution within appellants' claimed ranges, i.e., Rostoker appears to disclose a collection of particles which do

not include a tail. See Examiner's answer, page 6, first paragraph. In support of his position, the examiner references the teachings in column 7, the examples, and claim 10 of Rostoker. Id. Appellants argue that they are unable to understand Rostoker's teachings relating to particle distribution and, therefore, are unable to make a comparison with their claimed distributions. See Reply brief, page 8, second paragraph. We find the examiner's reference to specific teachings in Rostoker sufficient to establish a prima facie case of obviousness.[3]

With respect to the existence of a tail in Rostoker's collection of particles, we note that Rostoker discloses a quality factor "Q" which is inversely related to distribution of particle sizes. See Rostoker, column 7, lines 6-18. According to Rostoker, maintaining a high "Q", i.e., a high concentration of particles around the average particle size, ensures superior polishing because it minimizes particles which are significantly

[3]For appellants' reference, sample calculations showing the overlap in Rostoker's particle distribution with the claimed particle distribution is provided in the appendix attached hereto. The examiner and appellants may wish to consider whether Rostoker anticipates any of the claims as presently drafted in the event that appellants elect to continue prosecution of this application.

larger or smaller than the average. See column 7, lines 19-26 and lines 55-61. These teachings suggest that Rostoker's collection of particles have an extremely uniform particle size and do not include a tail. Accordingly, we find that the examiner has established a prima facie case of obviousness with respect to claims 1 and 19.

In support of their arguments that the claimed invention is nonobvious, appellants rely on the Kambe declaration. See Reply brief, page 8, last paragraph. We agree with the examiner that this declaration is unpersuasive since it fails to address the examiner's prima facie showing of obviousness of the claimed collections of particles. See Examiner's answer, page 7. "[T]he Kambe declaration was submitted by Applicants as support that other approaches for the formation of Applicants' claimed invention are not available." Reply brief, page 8, last paragraph. As discussed above, Rostoker teaches a collection of particles having sizes and distributions within the claimed ranges (see Examiner's answer, pages 7-8) and the claims as drafted are not limited to particles produced by a particular method. Further, as alluded to by the examiner (see Examiner's answer, page 8), Mr. Kambe's assertions are unsupported by any type of evidentiary showing.

Accordingly, the rejection is affirmed.

2. Rejection of claims 17 and 18 under 35 U.S.C. § 103 as unpatentable over Shimo

The examiner found that Shimo "teaches a method of making aluminum oxide which comprises all of the claimed steps and therefore no significant difference is seen to exist [between Shimo and the claimed invention] in the absence of any evidence showing the contrary." Examiner's answer, page 5, third paragraph. Appellants note that Shimo teaches a process wherein gaseous reactants are placed within a reaction chamber and therefore, "does not teach or suggest reacting a *flowing* reactant stream." Appeal brief, page 24, second paragraph. The examiner maintains that because Shimo's vapor has flowing capabilities, i.e., is not 100% still, it reads on the claimed method. Examiner's answer, page 7, second paragraph.

In general, claim terms in a patent application are given their ordinary meaning as used in the field of the invention unless the specification indicates that a word has special meaning. In re Thrift, 298 F.3d 1357, 1364, 63 USPQ2d 2002, 2006 (Fed. Cir. 2002). Appellants urge that the term "flow" means a net movement of fluid, not the capability to flow or the random

motions of individual gas particles. See Reply brief, page 12, third and fourth paragraphs (referencing the definition of flow from Webster's Tenth Collegiate Dictionary, attached to the reply brief). We also note that claim 17 utilizes the term "flowing" in conjunction with movement of a molecular *stream through* a reaction chamber. A "stream" is defined as a continuous procession moving in one direction. See, generally, Webster's Third New International Dictionary 2258 ([1]stream 2c)(1971). Accordingly, we agree with appellants that the language of claim 17 clearly defines over Shimo's method wherein the vapor reactants are held in a glass vessel during irradiation and are not in the form of a stream flowing through a reaction chamber.

The rejection is reversed.[4]

In summary, we affirm the rejection of claims 1-3, 5-16 and 19-22 under 35 U.S.C. § 103 as unpatentable over Rostoker alone or in view of Ueda and reverse the rejection of claims 17 and 18 under 35 U.S.C. § 103 as unpatentable over Shimo.

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[4] We base our reversal of this ground of rejection solely on the facts and reasons relied on by the examiner in support of the rejection. We note, in particular, that the examiner does not assert that it would have been obvious to have replaced Shimo's batch process wherein reactants are held in a chamber during irradiation with a continuous process wherein reactants flow through a reaction chamber during irradiation.

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

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|---|---|
| BRADLEY R. GARRIS<br>Administrative Patent Judge | |
| PAUL LIEBERMAN<br>Administrative Patent Judge | BOARD OF PATENT<br>APPEALS AND<br>INTERFERENCES |
| LINDA R. POTEATE<br>Administrative Patent Judge | |

LRP:pgg

APPENDIX

Rostoker teaches that:

> the alpha aluminum oxide particles used for polishing exhibit the following characteristics. Preferably, the particle size is "X" nm, and the distribution of particle sizes is controlled to within "Y" nm, and the particles used for polishing are "Z" percent (%) in the alpha phase, where: "X" is 10-100 nm; such as 10, 20, 30, 40 and 50 nm, and is preferably no greater than 50 nm; and "Y" is approximately "P" percent of "X", where "P" is 10%, 20%, 30%. 40% or 50%, and is preferably no greater than 50% to ensure a narrow (Gaussian) distribution of particle sizes about "X"; "Z" is at least 50%, including at least 60%, 70%, 80% and 90%, and as high as 100%.

Rostoker, column 7, lines 4-17.

EXAMPLE 1 (Rostoker): Average particle size X = 10 nm

1. Y = 10% of 10 nm (P x X) = 1 nm

Particle size distribution (X ± Y) = 9-11 nm (10 ± 1nm)

2. Y = 50% of 10 nm = 5 nm

Particle size distribution = 5-15 nm (10 ± 5nm)

COMPARISON EXAMPLE 1: Average particle size = 10 nm

<u>Claim 1</u>: Particle size distribution = 0-30 nm (10 x 3)

<u>Claim 19</u>: Particle size distribution = 4-16 nm (10 x .4; 10 x 1.6)

EXAMPLE 2: Average particle size = 100 nm

3. Y = 10% of 100 nm = 10 nm

Particle size distribution = 90-110 nm (100 ± 10)

4. Y = 50% of 100 nm = 50 nm

Particle size distribution = 50-150nm (100 ± 50)

COMPARISON EXAMPLE 2: Average particle size = 100 nm

Claim 1: Particle size distribution = 0-300 nm (100 x 3)

Claim 19: Particle size distribution = 40-160 nm (100 x .4; 100 x 1.6)

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**straw·less** \ˈ-ləs\ *adj* : containing no straw
**straw line** *n* : a light cable used to haul the heavier cables of a rigging used in skidding logs
**straw man** *n* : MAN OF STRAW
**strawmote** \ˈ-,-\ *n, dial Eng* : a single straw
**straw-necked ibis** \ˈ-,-\ *n* : an Australian ibis (*Threskiornis spinicollis* or *Carphibis spinicollis*) with modified feathers of the lower neck that are yellow and stiff and resemble straw
**straw oil** *n* : a high-boiling petroleum distillate similar to gas oil used chiefly in purifying coke-oven gas and other industrial gases
**straw plait** *n* : braided straw (as for making hats)
**straw ride** *n* : HAYRIDE
**straws** *pl of* STRAW, *pres 3d sing of* STRAW
**straw sedge** *n* : a common sedge (*Carex straminea*) of eastern No. America
**strawsmear** \ˈ-,-\ *n* 1 *or* **strawsmall** \ˈ-,-\ *Brit* : WHITETHROAT 1 2 *Brit* : GARDEN WARBLER 3 *Brit* : WILLOW WREN
**strawstack** \ˈ-,-\ *n* : a pile of grain straw from which the grain has been threshed
**strawstacker** \ˈ-,-,-\ *n* [*strawstack* + *-er*] : one that piles straw in a stack
**straw stem** *n* : a wineglass stem pulled out of the substance of the bowl; *also* : a wineglass having such a stem
**straw vote** *n* : an unofficial vote (as taken at a chance gathering or by letters of inquiry) to indicate the relative strength of opposing candidates or issues — called also *straw ballot*
**strawwalker** \ˈ-,-,-\ *n* : a device inside a thresher or combine that consists of reciprocating notched bars to push the straw to the rear of the machine
**straw wine** *n* : a sweet dessert wine that resembles liqueur and is produced from grapes partially dried often on straw and in the sun before fermentation
**strawworm** \ˈ-,-\ *n* 1 : CADDISWORM 2 : any of several larval chalcid flies that injure the straw of wheat and other grains (as barley)
**strawy** \ˈstrȯi, -ōē\ *adj* -ER/-EST [¹*straw* + *-y*] 1 : of, relating to, resembling, consisting of, or containing straw 2 *obs* : WORTHLESS, TRIFLING
**strawyard** \ˈ-,-\ *n, Brit* : a yard littered with straw for wintering or fattening livestock
**straw yellow** *n* : STRAW 6
¹**stray** \ˈstrā\ *vb* -ED/-ING/-S [ME *straien*, fr. MF *estraier* fr. (assumed) VL *extragare*, fr. L *extra-* outside + *vagari* to wander — more at EXTRA-, VAGARY] *vi* 1 a : to wander from company, from confinement or restraint, or from the proper limits : rove at large (leaving a gate open so that cattle ~ —Agnes M. Miall) (the two had ~ed apart where the woods were deepest —Mary Austin) b : to leave a natural or accustomed habitat or environment (fruit trees and ~ed garden flowers deep in the woods —Bernard DeVoto) (the most courteous . . . of eighteenth-century grands seigneurs ~ed out of his age into ours —Gerald Abraham) (of adults . . . at least one-tenth might never have ~ed outside in their lives —G.G. Coulton) 2 a : to roam about without fixed direction or purpose : wander at random (fetid back alleys where we sometimes ~ed —Marvin Barret) b : to move in a winding course : MEANDER c : to move without voluntary control or under external compulsion (my hand automatically ~s towards my pocket —*Sydney (Australia) Bull.*) (eyes ~ing absently around the room) 3 a (1) : to engage temporarily or momentarily in sinful, immoral, or other than praiseworthy actions or thoughts : ERR (2) : to think or utter ideas contrary to or different from an accepted dogma (those who ~ed from the party line —Kurt Glaser) b : to become distracted from an argument or chain of thought : take up a tangential point (I have ~ed from my . . . role of historian . . . to indulge in a bit of prophecy —J.B. Conant) 4 : to wander accidentally from a direct or chosen route : lose one's way : DEVIATE (~ed off the road . . . in the dark of the moon —Mary Webb) (the unit ~ed across the border by mistake —*Springfield (Mass.) Union*) 5 : to present a haphazard or unkempt appearance (black hair that ~ed carelessly about her face —Liam O'Flaherty) (a leading article (which regrettably ~s from page to page among the advertisements) —*Times Lit. Supp.*) ~ *vt* 1 *archaic* : to cause to stray 2 *archaic* : to roam through or over
²**stray** \"\ *n* -S [ME, fr. AF *estray*, fr. OF *estraié*, past part. of *estraier* to stray] 1 a (1) : a domestic animal that has left an enclosure or its proper place and company and wanders at large or is lost subject to impoundment and if unredeemed to forfeiture : ESTRAY (2) : an animal that has strayed (the shepherd rounded up the flock's ~s) (3) : an unidentified domestic animal (as a dog or an unbranded steer) wandering at large b (1) : a person or thing that strays or has strayed : a detached, isolated, or vagrant individual : STRAGGLER, WAIF (harbored white renegades and ~s from hostile tribes —*Amer. Guide Series: Tenn.*) (do not own more than three books other than casual contemporary ~s —J.W.Krutch) (2) : an animal or plant found outside its natural range or habitat or out of season c *obs* : a group of strayed animals, people, or things (hast thou seen a ~ of bullocks and of heifers pass this way —Joseph Addison) 2 [ME, fr. *straien* to stray] *archaic* : the act or process of going astray or of strolling aimlessly (I would not from your love make such a ~ —Shak.) 3 *Brit* : common land or pasturage; *also* : the right to allow one's stock to stray and feed thereon 4 a : an electrical effect that is not produced by a transmitting station and that disturbs the reception of receiving apparatus b : an electric wave or current causing a stray — compare ATMOSPHERICS 5 : an unexpected formation encountered in drilling an oil or gas well
³**stray** \"\ *adj* [²*stray*] 1 a : escaped from confinement, supervision, or restraint or from a group of its kind (~ cow) (~ dog) (~ child) b : having been lost, misplaced, or forgotten (the other fellows take handkerchiefs home and ~ coats sometimes —Janet Frame) 2 : wandering lost, aimless, or isolated from the normal or principal body, habitat, or course (details picked up from ~ survivors —John Mason Brown) (account for every ~ traveller in the mountains —Owen Wister) (a ~ enemy group may at any time swoop down —Ed Cunningham) 3 a : occurring or appearing sporadically or at random (~ acquaintances met with in hotel rooms and aeroplanes —*Geog. Jour.*) (the white dogwood were ~ handfuls of confetti in the young green —Horace Sutton) b : touched upon or met with only in passing or in haste : OCCASIONAL, INCIDENTAL (a series of scenes that (except for ~ ones) register honestly —John Kerry) (one or two ~ expressions that have evaded revision —*Times Lit. Supp.*) (a ~ weekly hour of hygiene —Hortense Calisher) c : scattered about (on our knees retrieving ~ cigarettes —A. Conan Doyle) (collecting ~ hairs from the farm horses' tails —W.P.Smith) (~ members of the congregation moved by the spirit may be prophesying in unknown tongues —W.L.Sperry) 4 : not serving any useful purpose : UNWANTED (necessarily results in serious errors when ~ light . . . is not absorbed by the optical system —H.A.Stahl) (insulate them . . . so that no ~ current is introduced into the circuit —A.C.Morrison) 5 : written hastily or thoughtlessly and published in obscure or ephemeral journals (wrote only one complete novel and a few ~ pieces and fragments —Henri Peyre)
**strayaway** \ˈ-,-,-\ *n* -S [*stray* + *away*] : one that strays away
**strayed** *past of* STRAY
**stray energy** *or* **stray power** *n* : electrical losses (as in a dynamo) due to friction, hysteresis, and eddy currents as distinguished from the loss from electric resistance in the conducting apparatus
**stray·er** \ˈstrāə(r)\ *n* . . .

ward —W.P.Smith) b (1) : an irregular strip or line of contrasting color or texture causing variation in or on a surface (faded ~s in a curtain where the sun hits it) (bacon with a thick ~ of lean) (2) : an incision made by chipping a pine tree for obtaining turpentine c : the color of the fine powder of a mineral obtained by scratching, pulverizing, or rubbing against a hard white surface, often differing from the color of the mineral in mass, and being important as a distinguishing character esp. for minerals having metallic luster d : an imperfection in glass consisting of a wavy or colored line that distorts an image e (1) : a threadlike striation (2) : inoculum implanted (as with a needle drawn across the surface) in a line or stripe upon a solidified culture medium (3) : STREAK CULTURE f (1) : any of several virus diseases of plants (as the potato, tomato, raspberry, or sugarcane) resembling mosaic but usu. producing at least some linear markings — compare BLUESTEM 2, TOMATO STREAK (2) : a disease of sweet peas caused by a bacillus (*Erwinia lathyri*) and characterized by brownish spots or streaks on the stem, petioles, and leaves 3 a : a narrow band of light (the first grey ~s of dawn —R.S. Porteous) (a ~ of moonlight came in through the window —Sherwood Anderson) (burning oil flew outwards in a ~ —Nevil Shute) b : a dart of lightning : BOLT (in dazzling ~s the vivid lightnings play —William Cowper) (off like a ~, heading . . . down the homestretch —*N.Y. Times*) 4 a : a slight admixture (as of an inherent character) : STRAIN, TRACE (the ~ of extreme stubbornness . . . was both his strength and his misfortune —J.K.Galbraith) (a ~ of Indian blood in him —A.W.Long) b : a brief run (as of luck) (when he hits a ~ . . . everything's dandy —Hamilton Basso) c : a consecutive series (as of victories or defeats) (had a long winning ~ and took the . . . lead —A.J.Liebling) d : a short interval or transitory phase : FIT, SPELL (got started on one of her talking ~s —Erskine Caldwell) 5 a : a long irregular strip (as of land or water) (a ~ of deep green brush marks the course of a creek —*Amer. Guide Series: Ark.*) b : a narrow layer (as of ore) : SEAM, VEIN (struck a pay ~ at a thousand feet)
²**streak** \"\ *vb* -ED/-ING/-S *vt* 1 : to make streaks on or in : STRIATE (the water was ~ed with the sunset colors —R.H. Newman) (the sense of living nature seems to ~ some of his more recent pages —Cecil Sprigge) 2 : to prepare a streak culture of ~ *vi* 1 a : to make streaks (ribbons of rust ~ down . . . from patches of corrugated iron on the roof —James Reynolds) b : to rush swiftly : BOLT, ROCKET (lightning ~s from cloud to cloud) (reporters . . . ~ed through the crowd and out of the doors searching for telephones —Erle Stanley Gardner) (jet planes ~ed to three new transcontinental speed records —*Newsweek*) (when the nurse opened the door, the cat ~ed in —Henrietta Weigel) 2 : to become streaked (hair beginning to ~ with gray)
³**streak** \"\ *vt* -ED/-ING/-S [ME *streken* to stroke, prob. fr. MD — more at STROKE] *obs* : RUB, SMEAR (with the juice of this I'll ~ her eyes —Shak.)
⁴**streak** *archaic var of* STRAKE
⁵**streak** \ˈstrēk\ *var of* STREEK
**streak culture** *n* : a culture inoculated with a streak
**streaked** \ˈstrēkt, -kəd\ *adj* [fr. past part. of ²*streak*] 1 : marked with or as if with stripes or linear discolorations : GRIZZLED, STRIATED (~ hair) (~ lumber) 2 : physically or mentally disturbed : stricken with illness or anxiety : SICK, UPSET (looked so ~ and so chopfallen, that I felt . . . sorry for him —T.C.Haliburton)
**streaked-back plover** \ˈ-ˌ-\ *n* : TURNSTONE
**streaked bass** *n* : STRIPED BASS
**streak·er** \ˈstrēkə(r)\ *n* -S [¹*streak* + *-er*; fr. the usu. seven black stripes from gill cover to tail base of the yellow bass] 1 : YELLOW BASS 2 : WHITE BASS 1
**streak·i·ly** \-kəlē, -li\ *adv* : in a streaky manner
**streak·i·ness** \-kēnəs, -kin-\ *n* -ES : the quality or state of being streaky
**streak lightning** *n* : CHAIN LIGHTNING
**streak plate** *n* : a piece of white unglazed porcelain on which to test the streak of a mineral
**streaky** \ˈstrēkē, -ki\ *adj* -ER/-EST [¹*streak* + *-y*] 1 a : resembling or characterized by streaks (a smoky fleece . . . brushed to give a ~ effect —*Women's Wear Daily*) b : marked with streaks (fat legs and dirty, ~ face —Hugh Walpole) c : having alternate streaks of fat and lean (~ bacon) 2 : APPREHENSIVE (as nervous and ~ about it as a cat on a hot rock —H.L.Davis) 3 : of mixed quality : VARIABLE, UNRELIABLE (humans are the most ~ of conceivable things —H.G.Wells)
¹**stream** \ˈstrēm\ *n* -S *often attrib* [ME *strem*, *streme*, fr. OE *strēam*; akin to OHG *stroum*, *strōm* stream, ON *straumr* stream, OIr *sruaimm* river, OSlav *struja* flow, Gk *rhysis* flow, *rhein* to flow, Skt *sravati* it flows, *sarati* it runs, flows — more at SERUM] 1 a : a body of running water flowing in a channel on the surface of the ground, in a cavern below the surface, or beneath or in a glacier (cross the river . . . not far from where General Washington forded the ~ —Gladys Taber) — compare CREEK, RIVER; see CURRENT table b : BROOK, RIVULET 2 a : a steady succession (as of words or events) (let loose a ~ of commentary and discussion —R.W.Southern) (life presents a perpetual ~ of problems —W.J.Reilly) b : a constantly renewed supply (the balanced budget . . . injects as much into the income ~ as it takes away —J.G.Gurley) (a steady ~ of material flowed into the Smithsonian from . . . all over the world —D.S. & Jessie Jordan) c : a continuous procession moving in one direction (sent a ~ of miners pouring . . . westward —R.A.Billington) (a ~ of Sunday traffic) (goats followed him — a long ~ that pattered on small sharp hoofs behind him —Stuart Cloete) 3 a : an outpouring of a fluid from a source or container (a ~ of water . . . from a fire nozzle —W.Y.Kimball) (pour a sticky ~ of syrup from a pitcher) (a reaction ~ can be switched from one line to the other —*Chem. & Engineering News*) b : an effusion of a bodily fluid (~s of sweat pour down his back) c : an unbroken flow (as of gas or particles of matter) (moisture was kept at a high level by a deep ~ of persistent northerly winds —*Farmer's Weekly (So. Africa)*) (an electric current is a ~ of . . . electrons —Leonard Engel) d (1) : a valley glacier (ice ~s coalesced to form a piedmont glacier —*Jour. of Geol.*) (2) : a lava flow esp. long and narrow (dated lava ~s —W.J.Miller) (3) : sand grains moving or having moved downwind in a fairly continuous mass (the dune advances . . . down the sand ~ —*Geog. Jour.*) — compare ROCK STREAM 4 a : a streak of light (the ashen ~ of daybreak —Ellen Glasgow) b *obs* : the tail of a comet (saw another comet . . . but the ~ not so long as the former —John Evelyn) 5 a : a relatively narrow well-defined and usu. swift oceanic current (the Gulf ~) b : the center of a body of running water where the current is swiftest (anchored out in the ~ and came ashore in a launch) c : the propulsive current of running water (floating straight, obedient to the ~ —Shak.) (row against the ~) d : a prevailing attitude or group (in full accord with the main ~ of British policy —*New Statesman & Nation*) e : a dominant influence or line of development (the two ~s of heredity . . . that shaped his life —C.A.Dinsmore) (academicians, man out of the main creative ~ of their time —Donald Mintz) (eddies in the great ~ of baroque music —P.H.Lang) 6 **streams** *pl, archaic* : flowing waters (a river . . . pours its ~s through a narrow vale —Sir Walter Scott) syn see FLOW — on stream : in or into production (the refinery could be on stream within four or five weeks —Clifton Daniel) (our Baton Rouge plant will go on stream, it is expected, in June of this year —*Ethyl News*)
²**stream** \"\ *vb* -ED/-ING/-S [ME *stremen*, fr. *strem*, *streme* . . .

teristic of its flight —*Nat'l Geographic*) (the boy, with . . . ~ing-back, was rushing helter-skelter down the hill . . . Galsworthy) 4 : to pour in large numbers in one direction (passengers . . . ~ed ashore on seven of the eight gangways —Vernon Pizer) (rooks went ~ing across the windy sky —Mary Webb) (innumerable requests and invitations . . . ~ in —Robert Bendiner) ~ *vt* 1 : to emit or cause to flow : . . . (his eyes ~ed tears) 2 : to wave or display fully extended (its radiator grille ~ing a flag —Kathryn Grondahl) 3 : to . . . into the water : allow (a tow) to run out to full length (~ an anchor buoy) (~ a paravane) (~ a grass line so that the other ship can grapple it and pick it up —*Manual of Seamanship*) 4 : to subject to the action of water as a means of exposing ore : WASH (slaves were ~ing the gravel for tin ore —Charles Kingsley) syn see POUR
**stream anchor** *n* : a light anchor for use with a bower in narrow waterways
**stream cable** *n* : the cable of a stream anchor
**stream capture** *n* : CAPTURE 3
¹**stream·er** \ˈstrēmə(r)\ *n* -S [ME *stremer*, fr. *stremen* to stream + *-er* — more at STREAM] 1 a : a flag that streams in the wind; *esp* : PENNANT b : a wavy band resembling a fluttering pennon (clouds . . . like ~s of snow —O.E.Rölvaag) c : a narrow free-floating strip (as of cloth or crepe paper) (a hat with ~s down the back) (a hall festooned with ~s) d : STREAMER FLY e : a ribbon poster esp. used in a window or store display and often having a single line of wording f : BANNER 4 g : a parachute that streams out from the pack but fails to blossom 2 a *obs* : the tail of a comet b : a long gauzelike extension of the solar corona brighter at the base and fading to invisibility at the end, sometimes showing filamentous structure, and visible only during a total solar eclipse c **streamers** *pl* : AURORA BOREALIS d : a visible brush discharge streaming out from some part of an electric circuit or charged body — compare CORONA 2g 3 : one that washes sand or gravel in search of ore syn see FLAG
²**streamer** \"\ *vt* -ED/-ING/-S : to provide or decorate with streamers
**streamer fly** *n* : any large wet fisherman's fly with long streamer feathers, hair, or other appendages extending out behind the hook and from the head
**stream feeding** *n* : a method of feeding in which sheets are overlapped as they approach the front guides on the feedboard of a printing press
**streamflow** \ˈ-,-\ *n* : water flowing in a stream channel; *specif* : the velocity and volume of such water
¹**stream·ing** \ˈstrēmiŋ, -mēŋ\ *n* -S [ME *streming*, fr. gerund of *stremen* to stream — more at STREAM] : an act or instance of flowing; *specif* : CYCLOSIS
²**streaming** *adj* [fr. pres. part. of ²*stream*] : issuing in or suffused with streams : FLOWING, RUNNING (a ~ cold) (a ~ umbrella) (a ~ sunset) — **stream·ing·ly** *adv*
**streaming potential** *n* : a potential difference that arises across a capillary tube or membrane when a liquid is forced through it — compare ZETA POTENTIAL
**stream jam** *n* : a log jam that reaches neither shore — called also *center jam*
**stream·less** \ˈ-ləs\ *adj* : having no stream
**stream·let** \-lət\ *n* -S [¹*stream* + *-let*] : a small stream
¹**streamline** \ˈ-,-\ *n, often attrib* [¹*stream* + *line*] 1 a : LINE OF FLOW (~s of liquid flowing in a constricted tube —H.B. Lemon & Michael Ference) b : the path of a fluid particle relative to a solid body past which the fluid is moving in smooth flow without turbulence (consider the ~s . . . around the plane parts —S.A.Moss) 2 a : a contour offering minimum resistance to a current (probably no animal or plant in the water is without some touch of ~ —R.E.Coker) (the ~ of an airfoil) (the island . . . was formed generally in a ~ —Norman Mailer) b : a fluid line (~ may not improve the performance of a typewriter but it makes it look efficient)
²**streamline** \ˈ-;-\ *vt* 1 a : to adapt to a line of flow (even without human assistance the controls of an airplane tend to ~ themselves) b : to provide with a contour offering minimum resistance to a current (the fish is the first organism to have its hind appendage . . . ~ed into it —A.L.Kroeber) (the nose is well ~ed with aluminum cowling giving a bullet-like appearance —*Aero Digest*) c : to design with flowing contours (~ apparatus for greater cleanliness and safety —D.E.Pierce) 2 : to bring up to date : renovate in appearance or attitude : MODERNIZE (wants to ~ his people by treading on their fondest superstitions —Joseph Hitrec) (the archaic judiciary system has been ~ed —T.H.Fielding) (~ the text, to bring it closer to the contemporary stage —John Mason Brown) 3 a : to impose order or discipline upon : INTEGRATE, ORGANIZE (everything is ~ed — doctrine, tactics, production, armaments, all integrated, all enshrined in a single dynamic —Lewis Hastings) b : to make simpler or more efficient (machines that extrude damp clay . . . ~ the work of clay modelers —*Ford Times*) (enacted legislation combining our armed forces into a single department of defense to ~ our defense machinery —*Think*) c : to reduce to a minimum (school terms were ~ed . . . to get the graduate sooner for industry —E.C.McVoy)
**streamlined** \ˈ-;-\ *adj* 1 a : affording minimum resistance to a current : contoured to reduce drag (a ~ yacht) (~ engine nacelles) (~ hounds chase a fleeing mechanical rabbit —*Amer. Guide Series: Ark.*) (go easy on ice cream till we get the figure a bit more ~ —*Auckland (New Zealand) Weekly News*) b : stripped of nonessentials : SIMPLIFIED, COMPACT (a ~ ticket . . . replacing the long tickets previously used for transcontinental travel —*Wall Street Jour.*) (all-steel kitchens, ~ and efficient, with no empty spaces or useless nooks —Harriette Arnow) c : effectively integrated : ORGANIZED (the shrinking of the world . . . requires ~ and internationally uniform laws of aviation —*Air Transportation*) 2 : having fluid lines : CURVILINEAR (~ watch bracelet) (~ pressure cooker) 3 : brought up to date : MODERNIZED (jumped from the oxcart to the ultra ~ —*Holiday*) (has fashioned . . . a ~ version of the . . . novels —J.T.Winterich) 4 : of, relating to, or characteristic of streamline flow : LAMINAR (the flow of the unagglutinated blood is laminar or ~ —*Science*)
**streamline flow** *n* : an uninterrupted flow (as of air) past a solid body in which the direction at every point remains unchanged with the passage of time : LAMINAR FLOW — compare TURBULENT FLOW
**streamliner** \ˈ-;-,-\ *n* : one that is streamlined; *esp* : a streamlined train
**streamlining** *n* [fr. gerund of ²*streamline*] 1 a : contouring for minimum resistance to a current (the ~ of aircraft) b : curvilinear design (the ~ of household appliances is more decorative than functional) 2 : revision to increase efficiency or eliminate what is obsolete or nonessential : MODERNIZATION, SIMPLIFICATION (the ~ of factory operations —*Nat'l Stationer*) (~ certainly reduced the number of opportunities for misunderstanding —*Jour. of Accountancy*)
**stream of consciousness** 1 : individual conscious experience considered as a series of processes, intrapsychic events, or experiences continuously moving forward in time — compare CONSCIOUSNESS 3 2 : INTERIOR MONOLOGUE
**stream orchid** *n* : a helleborine (*Epipactis gigantea*) native to western No. America and having greenish or purplish pendulous flowers — called also *giant helleborine*
**stream piracy** *n* : CAPTURE 3
**streams** *pl of* STREAM, *pres 3d sing of* STREAM
**streamside** \ˈ-,-\ *n* : the land bordering on a stream
**stream terrace** *n* : one of a series of terraces cut usu. out of . . .

The opinion in support of the decision being entered today was *not* written for publication and is *not* binding precedent of the Board.

Paper No. 30

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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BOARD OF PATENT APPEALS
AND INTERFERENCES

*Ex parte* SUJEET KUMAR,
HARIKLIA DRIS REITZ, XIANGXIN BI
and
NOBUYUKI KAMBE

Appeal No. 2001-1031
Application No. 09/136,483

ON BRIEF

Before GARRIS, LIEBERMAN, and POTEATE, *Administrative Patent Judges*.

POTEATE, *Administrative Patent Judge*.

***ON REQUEST FOR REHEARING***

Appellants request rehearing of our Decision on Appeal entered February 27, 2003 (Paper No. 28), wherein we affirmed the examiner's final rejection of claims 1-3, 5-16 and 19-22 as unpatentable over Rostoker alone or in view of Ueda.

Denied.



Appeal/CAFC deadline 10-20-03

*OPINION*

Appellants argue that the Board erred in its decision to affirm the examiner's rejection for essentially the following three reasons:

1. The Board improperly construed the term "comprising" in the claims to include additional particles (e.g., a tail) that have properties which are at odds with the specific characteristics recited in the claims. See Request for Reconsideration, Paper No. 29, received May 2, 2003, paragraph bridging pages 3-4.

2. The Board's analysis of Rostoker's particle size distribution (Rostoker, column 7, lines 4-26) ignores the discussion of the quality factor "Q" and, therefore, is based on factual error. See *id.*, pages 4-6.

3. The examiner and the Board mistakenly placed the burden on applicants to establish that the disclosure in the Rostoker patent does not enable one of ordinary skill in the art to practice applicants' claimed invention. See *id.*, pages 6-11.

We have carefully considered the arguments presented by the appellants, but we are not persuaded that our decision to affirm the examiner's final rejection of the claims as

unpatentable under 35 U.S.C. § 103 was in error. We respond to each of the issues raised by appellants in detail below.

### *1. Whether the Board erred in interpreting the term "comprising" to include the presence of a tail*

As correctly pointed out by appellants, during patent prosecution, claim language is given its broadest reasonable interpretation consistent with the Specification. ***In re Morris***, 127 F.3d 1048, 1054, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997). According to appellants, the Board's interpretation of the word "comprising" to include a particle collection having a tail "is especially at odds with Applicants' specification since the specification states that the plot of particle diameters does <u>not</u> have a tail at large diameters." Request for Reconsideration, page 4. In support of their position, appellants reference the Specification, page 20, line 16 to page 21, line 10.

Claim 1 requires that the collection of particles include less than about 1 in $10^6$ particles having a diameter greater than about three times the average diameter of the collection of particles. The above referenced portion of the Specification includes the statement "[a]n effective cut off in the tail indicates that there are less than about 1 particle in

$10^6$ hav[ing] a diameter greater than a particular cut off value above the average diameter." See specification, page 21, lines 3-7. Accordingly, we are in agreement with appellants that claim 1, as drafted, precludes the presence of a tail. Therefore, we modify our Decision on Appeal to the extent that it is inconsistent with our conclusion that the term "comprising" in claim 1 precludes the presence of particles which constitute a tail. This modification does not, however, effect our conclusion that the invention as claimed in claim 1 is obvious.

Claim 19 does not include the above-noted limitation recited in claim 1. Rather, "claim 19 is specifically directed to the sharp drop in the distribution of particle sizes away from the average particle size. This narrow distribution about the average ***is independent from the lack of a tail*** in the distribution, although they both relate to the overall particle size distribution." Appeal Brief, Paper No. 19, received September 5, 2000, page 4. Thus, we remain of the opinion that use of the term "comprising" in claim 19 does not preclude the presence of a tail.

***2. Whether the Board erred in its analysis of the discussion in Rostoker relating to particle size distribution***

The Federal Circuit requires that the Board, in its decisions, "set forth its findings and the grounds thereof, ***as supported by the agency record***, and explain its application of the law to the found facts." ***In re Lee***, 277 F.3d 1338, 1342, 61 USPQ2d 1430, 1433 (Fed. Cir. 2002). Thus, in the present case, our decision was based on the examiner's findings that Rostoker discloses a collection of particles having both the sizes and distribution within appellants' claimed ranges (see Examiner's Answer, Paper No. 22, mailed November 16, 2000, page 3, penultimate paragraph, referencing Rostoker, column 4, lines 12-24 and page 5, last paragraph, referencing column 7, lines 4+). See Decision on Appeal, paragraph bridging pages 7-8.

As noted in our Decision on Appeal, we found the examiner's reference to these specific teachings in Rostoker "sufficient to establish a prima facie case of obviousness." ***Id.***, page 8. Our discussion of quality factor "Q" and sample calculations were merely "[f]or appellants' reference." ***Id.***, footnote 3. In the Reply Brief, Paper No. 24, received January 8, 2001, page 8, second paragraph, appellants indicated that they

did not understand the particle size distribution formulae explained in column 7 of Rostoker. Interestingly, appellants now proffer the declaration of Professor Singh in an effort to not only refute the Board's findings regarding Rostoker's particle size distribution, but also for the purpose of providing a detailed analysis of Rostoker's particle size distribution formulae.

Although it is true that the initial burden of presenting a ***prima facie*** case of obviousness rests on the examiner, ***In re Oetiker***, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992), where, as here, the examiner has demonstrated that a reference teaches overlapping ranges, the burden shifts to the appellants to rebut the examiner's ***prima facie*** case of obviousness. ***In re Inland Steel Co.***, 265 F.3d 1354, 1363, 60 USPQ2d 1396, 1403 (Fed. Cir. 2001). While expert declarations are an appropriate form of rebuttal evidence, we decline to consider Professor Singh's declaration since appellants have failed to provide a showing of good and sufficient reasons as to why this declaration was not earlier presented. See 37 CFR § 1.195.

***3. Whether the Board erred in concluding that the Rostoker patent enabled practice of Applicants' claimed invention without undue experimentation***

According to appellants,

> ***[w]hile the Rostoker patent does not indicate that the Siegel method is the only way of making the particles, the mere suggestion that it is not limited to the Siegel method is not the equivalent of enabling disclosure. . . .***
>
> Applicants' [sic] have presented ***unrebutted*** evidence that the Siegel patent does not enable the practice of Applicants' claimed invention . . . . A person of ordinary skill in the art would need to exert at least undue experimentation unless the skilled artisan knows how to make or obtain the claimed particles without any further guidance since Rostoker does not provide any guidance.

Request for Reconsideration, page 9.

The examiner found that Rostoker discloses a polishing composition comprising a collection of particles which meet the limitations recited in claims 1 and 19. Further, Rostoker claims a method of polishing a substrate using a medium of aluminum oxide particles having sizes and a distribution which overlap those of the present invention. ***See*** claim 10. 35 U.S.C. § 282 (February, 2003) provides that "[e]ach claim of a patent . . . shall be presumed valid." A reference is presumed operable and

the burden is on the applicant to provide facts rebutting this presumption of operability. ***See In re Sasse***, 629 F.2d 675, 681, 207 USPQ 107, 111 (CCPA 1980). For the reasons stated in our Decision on Appeal (see page 9), we do not find appellant's arguments persuasive in overcoming the presumption of operability of the Rostoker patent.

In sum, while we have reviewed our decision in light of the appellants' Request for Reconsideration, we have decided not to modify our conclusion that claims 1-3, 5-16 and 19-22 are unpatentable under 35 U.S.C. § 103.

Appeal No. 2001-1031
Application 09/136,483

***TIME PERIOD FOR RESPONSE***

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

***DENIED***

| | |
|---|---|
| BRADLEY R. GARRIS<br>Administrative Patent Judge | ) |
| PAUL LIEBERMAN<br>Administrative Patent Judge | ) BOARD OF PATENT<br>APPEALS<br>AND<br>INTERFERENCES |
| LINDA POTEATE<br>Administrative Patent Judge | ) |

LRP:psb

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# UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

## NOTICE OF ENTRY OF
## JUDGMENT ACCOMPANIED BY OPINION

OPINION FILED AND JUDGMENT ENTERED: 08/15/05

The attached opinion announcing the judgment of the court in your case was filed and judgment was entered on the date indicated above. The mandate will be issued in due course.

Information is also provided about petitions for rehearing and suggestions for rehearing en banc. The questions and answers are those frequently asked and answered by the Clerk's Office.

No costs were taxed in this appeal.

Regarding exhibits and visual aids: Your attention is directed to FRAP 34(g) which states that the clerk may destroy or dispose of the exhibits if counsel does not reclaim them within a reasonable time after the clerk gives notice to remove them. (The clerk deems a reasonable time to be 15 days from the date the final mandate is issued.)

Jan Horbaly

JAN HORBALY
Clerk

cc: PETER S. DARDI
JOHN M. WHEALAN

IN RE KUMAR, O4-1074
PTO - 09/136,483

# United States Court of Appeals for the Federal Circuit

04-1074
(Serial No. 09/136,483)

IN RE SUJEET KUMAR, HARIKLIA DRIS REITZ,
XIANGXIN BI, and NOBUYUKI KAMBE

Peter S. Dardi, Patterson, Thuente, Skaar & Christensen, P.A., of Minneapolis, Minnesota, for appellants. With him on the brief was Tye Biasco. Of counsel were Randall T. Skaar and Eric H. Chadwick.

John M. Whealan, Solicitor, Office of the Solicitor, of Arlington, Virginia, for the Commissioner of Patent and Trademarks. With him on the brief were James R. Hughes and Stephen Walsh, Associate Solicitors.

Appealed from: United States Patent and Trademark Office
Board of Patent Appeals and Interferences

# United States Court of Appeals for the Federal Circuit

04-1074
(Serial No. 09/136,483)

IN RE SUJEET KUMAR, HARIKLIA DRIS REITZ,
XIANGXIN BI, and NOBUYUKI KAMBE

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DECIDED: August 15, 2005

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Before NEWMAN, Circuit Judge, ARCHER, Senior Circuit Judge, and DYK, Circuit Judge.

NEWMAN, Circuit Judge.

Sujeet Kumar, Hariklia Dris Reitz, Xiangxin Bi and Nobuyuki Kambe (together "Kumar") appeal the decision of the Board of Patent Appeals and Interferences of the Patent and Trademark Office, rejecting claims 1-3, 5-16, and 19-22 of patent application Serial No. 09/136,483 entitled "Aluminum Oxide Particles" as obvious under 35 U.S.C. §103. We vacate the Board's decision and remand for further proceedings.

Rostoker particles and of Kumar's claimed particles are overlapping. Kumar concedes that the Rostoker particles overlap the Kumar particles in average particle size, but argues that they do not overlap in particle size distribution. The appeal relates primarily to the Board's procedure, wherein the values deemed to overlap appear for the first time in the Board's decision. Kumar states that he was unfairly precluded from replying to this evidence, and that the Board improperly refused to consider the responsive evidence submitted with Kumar's request for reconsideration.

The Board's calculations were derived from the Rostoker reference, which describes aluminum oxide having a particle size and size distribution as follows:

> According to the invention, the alpha aluminum oxide particles used for polishing exhibit the following characteristics. Preferably, the particle size is "X" nm, and the distribution of particle sizes is controlled to within "Y" nm, and the particles used for polishing are "Z" percent (%) in the alpha phase, where:
>
> "X" is 10-100 nm, such as 10, 20, 30, 40 or 50 nm, and is preferably no greater than 50 nm; and
>
> "Y" is approximately "P" percent of "X", where "P" is 10%, 20%, 30%, 40% or 50%, and is preferably no greater than 50% to ensure a narrow (Gaussian) distribution of particle sizes about "X";
>
> "Z" is at least 50%, including at least 60%, 70%, 80% and 90%, and as high as 100%.
>
> A quality factor "Q" is inversely related to "Y", and is a measure of the distribution of particle sizes. "Q" can be calculated as the concentration of particles at the desired size "X", divided by the range of sizes of particles at 3 db (decibels) lower than "X". Preferably, the size distribution of alpha aluminum oxide particles used for polishing exhibits a "Q" of at least 10, including 10, 50, 100, 500, 1000, 5000, or 10,000 ("Q" is dimensionless).

Rostoker patent, col. 7, lines 4-27. The Board selected "X" and "P" values in the range disclosed by Rostoker, 10 nm and 10% respectively, to calculate a "Y" value of 1 nm (10

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tennis balls may have the same average size as a collection of (2) basketballs, baseballs and golf balls, but group (2) has a larger size distribution.

Produkter AB, 892 F.2d 1547, 1551 (Fed. Cir. 1989), for the rule that "[i]n order to render a claimed apparatus or method obvious, the prior art must enable one skilled in the art to make and use the apparatus or method." See also Motorola, Inc. v. Interdigital Tech. Corp., 121 F.3d 1461, 1471 (Fed. Cir. 1997); In re Payne, 606 F.2d 303, 314 (CCPA 1979). The Board rejected the Kambe declaration, finding that Mr. Kambe's assertions were conclusory and unsupported by evidence.

Kumar requested Board reconsideration, submitting the declaration of Dr. Rajiv Singh, Professor of Materials Science and Engineering at the University of Florida at Gainesville. Professor Singh explained that Rostoker's "Q" value defines size distribution, and criticized Rostoker's description of the "Q" value as internally inconsistent and not in conformity with standard representations of distribution functions. Professor Singh pointed out that Rostoker stated that he used the manufacturing method of Siegel, U.S. Patent No. 5,128,081, and opined that Siegel does not produce submicron particles. The Board refused to consider Professor Singh's declaration, ruling that Kumar had not shown good and sufficient reason why it was not earlier presented.

Kumar appeals, stating that a *prima facie* case of obviousness was not established, or if established was rebutted. Kumar objects to the tardy submission of the Board's calculations and states that he was entitled to consideration of Professor Singh's evidence. Kumar argues that the Singh evidence rebuts the *prima facie* case and that the Board should have either considered it or remanded to the examiner for that purpose.

DISCUSSION

Determination of obviousness under 35 U.S.C. §103 is a legal conclusion based on underlying facts. Graham v. John Deere Co., 383 U.S. 1, 17 (1966); In re Oetiker, 977

average diameter of 10 nm is selected (10 nm times 40% and 160% equals 4 and 16 nm, respectively).

Kumar argues that Rostoker's description of its particles is too indefinite to support any particular distribution of particle sizes. Kumar states that a skilled artisan would not understand Rostoker's "Y" variable to have the values that the Board calculated because Rostoker, in addition to stating that "Y" is approximately "P" percent of "X," requires that its particles meet a quality factor "Q" that is inversely related to "Y." Kumar argues that this renders the calculation of "Y" more complex than the Board's simplified calculation, and that Rostoker does not disclose the values the Board calculated and then used to conclude that Kumar's size distribution overlaps with that of Rostoker. Kumar also states that the Board should have provided an opportunity to support this argument with evidence showing that the Rostoker teachings do not support the Board's *sua sponte* calculations. Kumar states that the Singh declaration establishes the indefiniteness of the Rostoker reference, and challenges the assumptions underlying the Board's calculations.

The PTO responds that Rostoker's quality factor "Q" describes the extent to which his particle size distribution is controlled to within certain limits of the target particle size. The PTO suggests that Q is calculated as follows: Rostoker calls for the division of the amount of particles at the desired size X, by the amount of particles at a size 3 decibels ("db") from X. To find a value 3 db from X, which the Board labels "A," one must solve the logarithmic function, 10 log (X/A) = 3 db. The PTO solves this function and finds that if log (X/A) = 3/10, then X/A = $10^{3/10}$, and thus X/A = 2, and A = X/2. This means that a value that is 3 db lower than X is X/2 or 50% of X. Thus the PTO states that the quality factor Q merely describes the extent to which the particles are within 50% and 150% of the target

Instead of basing its decision on the values directly disclosed by Rostoker, the Board "went off on its own in considering the differences" between Rostoker and the Kumar invention, see In re Eynde, 480 F.2d 1364, 1371 (CCPA 1973), the Board calculating particular distribution values based on the assumption that the Rostoker variables "X," "Y," "P," and "Q" would be understood by a skilled artisan in the same way in which they were understood by the Board. The Singh declaration challenges the Board's view of the Rostoker variables. While the PTO now argues that there is no merit to the Singh position, and offers its own explanation for the meaning of the "Q" variable, the merits of this evidence are not properly debated in the first instance on appeal. There is no record on this aspect, for the Board refused to consider it.

In accordance with the Administrative Procedure Act, the agency must assure that an applicant's petition is fully and fairly treated at the administrative level, without interim need for judicial intervention. See Dickinson v. Zurko, 527 U.S. 150, 154 (1999) (the PTO is an agency subject to the Administrative Procedure Act). The Board's rules are in accord. See 37 C.F.R. §1.196(b) (when the Board relies on a new ground of rejection, it is appropriate to provide the applicant with an opportunity to respond to that ground).

When a rejection for obviousness is based on overlapping values in the prior art, identification of the values deemed to overlap is material to the rejection. In this case the overlapping values were identified for the first time in the decision of the Board, and are not themselves set forth in Rostoker or any other reference. In calculating the overlapping values, the Board found facts not found by the examiner regarding the differences between the prior art and the claimed invention, which in fairness required an opportunity for response. See In re Kronig, 539 F.2d 1300, 1302 (CCPA 1976) ("the ultimate criterion of

ordinary skill to make and use the invention. Beckman Instruments, 892 F.2d at 1551. Thus when a *prima facie* case of obviousness is deemed made based on similarity to a known composition or device, rebuttal may take the form of evidence that the prior art does not enable the claimed subject matter. See Payne, 606 F.2d at 314-15 ("the presumption of obviousness based on close structural similarity is overcome where the prior art does not disclose or render obvious a method for making the claimed compound"); In re Hoeksema, 399 F.2d 269, 274 (CCPA 1968) ("the absence of a known or obvious process for making the claimed compounds overcomes a presumption that the compounds are obvious, based on close relationships between their structures and those of prior art compounds").

The applicant has the burden of coming forward with evidence in rebuttal, when the prior art includes a method that appears, on its face, to be capable of producing the claimed composition. This burden may be met by presenting sufficient reason or authority or evidence, on the facts of the case, to show that the prior art method would not produce or would not be expected to produce the claimed subject matter. Since Rostoker states that its particles were made by the method shown in the Siegel patent, it was reasonable for Kumar to argue that the Siegel process would not produce Kumar's particles. Kumar's argument was supported by the declarations of Drs. Kambe and Singh. Whether these expert declarations are sufficient, without experimental data or other evidence, is a question of fact to be determined on the record. Although the PTO now argues that the Singh declaration is insufficient, the Board erred in refusing to consider the Singh declaration, for Kumar correctly observed that the issue was not presented until the Board made its *sua sponte* calculations of particle size distribution. The Board's calculations

## CONCLUSION

In view of our holding that Kumar was entitled to respond to the evidence adduced *sua sponte* by the Board, we vacate the Board's decision and remand for appropriate further proceedings.

VACATED AND REMANDED